THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 42. Thursday, March 27, 1930. No. 710.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,

49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (4 lines).

Contents.

	PAGE
Forthcoming Events	225
Silicosis Again	225
Trade-Marked Castings	225
Dr. Werner in London	226
Publication Received	226
Catalogues Received	226
Junior Foundrymen Hold Annual Social	226
Random Shots	226
Recent Research on Moulding Sands	227
Applications for Trade Marks	227
High-Quality Cast Iron for Cylinders	228
Contracts Open	228
Gases in Copper and their Removal	229
Reports and Dividends	230
Modern German Methods of Manufacturing Cast-Iron Baths and Other Sanitary Ware	231
Lincolnshire Iron and Steel Institute	233
Welding Cast Iron	234
The Iron and Steel Industry Since the War	237
The Continental Steel Cartel	238
A Welding Research Department and Training School	239
Cast-Iron Castings of High Silicon Content	240
Trade Talk	242
Personal	242
Obituary	242
New Companies	242
Iron and Steel Markets	244

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1929-30:

Wesley Lambert,
J. Stone & Company, Limited, Deptford, London, S.E.14.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.

Birmingham: F. K. Neath, 24, St. Paul's Square, Birmingham.

Sheffield: T. R. Walker, 26, Castlewood Road, Fulwood, Sheffield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

Lancashire: H. Stead, 1st/36, Cheetham Hill Road, Stalybridge, Cheshire.

London: H. G. Sommerfield, Charterhouse Chambers, Charterhouse Square, London, E.C.1.

Newcastle-upon-Tyne: F. Sanderson, 15, Handyside Arcade, Newcastle-upon-Tyne.

East Midlands: H. Bunting, 82, Otter Street, Derby.

West Riding of Yorkshire Branch: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

Wales and Monmouth Branch: J. J. McClelland, M.I.Mech.E., Druslyn, Bishops Road, Whitchurch, Glam.

Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades Equipment and Supplies Association.

President: H. Winterton,
Kelvinvale Mills, Maryhill, Glasgow.

Secretary: K. W. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 20, Fisher Street, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:—

24, ST. PAUL'S SQUARE, BIRMINGHAM.

Telephone: Central 1885. Telegrams: CIRA.

The B.C.I.R.A. Scottish Laboratories are:—

Foundry Technical Institute, Meek's Road, Falkirk *(Telephone 332)*

Forthcoming Events.

APRIL 1.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "The Heat-Treatment of Cast Iron," Paper by R. Whitfield.

Institute of British Foundrymen.

APRIL 5.

Lincolnshire Branch:—Annual business meeting. "Some Aspects of Foundry Service to Engineers," Paper by Messrs. E. J. L. Howard and H. Milner.

West Riding of Yorkshire Branch:—Ordinary meeting at Bradford. "Some Notes on Jobbing Moulding." Paper by A. S. Worcester.

Wales and Monmouth Branch:—Annual meeting at Cardiff.

Silicosis Again.

The appointment by the Medical Research Council of a Committee to study silicosis will recall to our readers the comments we made in these columns on the subject about eighteen months ago, in connection with the then pending issue of regulations. At that date we had occasion to stress the fact, not always appreciated either in the foundry world or out of it, that the ordinary process of founding might technically be regarded as within the scope of regulations intended primarily to cover the manufacture of refractory materials. It has become necessary to repeat the statement and the warning. In January of this year the Home Secretary issued a draft of the regulations which it was proposed to incorporate in the Factory Acts. These would supersede certain regulations issued since 1919 in connection with the handling of refractory materials. The changes embodied therein arise from the fact that several cases of silicosis have occurred in the refractory industries during the period in question, and it has been thought that the fault must lie with the present and presumably inadequate regulations for the suppression of dust, which is the primary cause of silicosis.

These regulations have been duly considered by the manufacturers' associations concerned with founding, and we believe that the necessary action has been taken. Nevertheless it is thought desirable to acquaint the industry with the position, because rigid insistence on the regulations as they stand would undoubtedly bring founding almost to a standstill. The point of first importance is that the regulations are intended to cover shops handling refractory materials that contain 80 per cent. total silica. They applied originally to silica brick, but the scope is now extended to bring in other refractory materials. Whether the Home Office is aware of it or not, this would automatically include ordinary moulding sand, the bulk of which contains over 80 per cent. silica, while core sands always do so. The main object of the new regulations is to minimise the production of very fine dust. To this end, conveyors, sieves, mixers, etc., have to be enclosed and provided with exhaust draft. The material must not be loaded or unloaded, shovelled or manipulated until effectively damped. Furthermore, the use of drying stoves is prohibited.

The present case is an instance of legislation by the issue of official regulations—legislation, that is, which does not come in for general public discussion unless the parties concerned choose to lodge objections. It demonstrates forcibly how desirable it is that the trade organisations concerned should hold a perpetual watching brief in these matters. We do not doubt in this instance that a satisfactory solution will be forthcoming. So far as we are aware there is no evidence that the problem of silicosis is present in the foundry trade so as to afford justification to the introduction of such regulations, so that no great difficulty should present itself in finding a solution.

Trade-Marked Castings.

It is pertinent to ask whether all the work done with the object of producing cast iron having superior mechanical strength has been worth while from a balance-sheet point of view. Initially, it can be stated that there is a tendency by all thinking people not to regard high tensile strength as the *alpha* and *omega* of strength criteria, but merely as indicating a material which will probably possess very desirable engineering properties. We must accord to Germany the palm for having popularised high-strength cast iron more than to any other section. This is the natural result of their enviable employers' federation. Thus we can turn to that country to inquire as to whether a profitable market exists for this recently developed material. The answer was supplied by Dr. Werner, the president of the German Foundry Owners' Federation when lecturing before the London Section of the Institute of British Foundrymen last Thursday. The doctor produced a diagram showing that the price received for the highest grades of cast iron were within measurable reach of that paid for steel castings, and on a strength-price ratio the engineer was presented with a convincing argument in favour of the replacement of steel by high-grade iron.

It must be conceded, however, that the national German organisation has had considerable influence in obtaining for the foundry owner prices commensurate with his costs of production, and thus the problem, so far as this country is concerned, still remains unsolved. What can be done, however, is the fullest utilisation of the protection given by a trade-mark. Only last Monday we inspected the works of Qualcast, Limited, and there the policy of the directorate is to mark, wherever the customer's permission can be obtained, each pattern, so that every casting is an advertisement for its producer. We are unaware as to whether the same policy is being pursued by the manufacturers of Perlit iron, and we throw out the suggestion that the licensees of this, as well as manufacturers of other high-grade irons, should make the fullest use of trade-marks. In the case of foundries making nickel iron, it would be of the greatest advantage to posterity, because it would prevent the accidental incorporation of nickel in sash-weight castings and the like. The fundamental principle is to stop selling grey-iron castings and to provide industry with trade-marked engineering parts.

XUM

Dr. Werner in London.

Last Friday a number of people prominent in the foundry industry met at the Savoy Hotel to tender to Dr. Ing. S. G. Werner, the President of the German Foundry Owners' Federation, a complimentary luncheon. The company was presided over by Sir Robert Donald, the Chairman of The Foundry Trade Journal. Dr. Werner's health was proposed by Mr. Vincent C. Faulkner, a Past-President of the Institute of British Foundrymen. Mr. Faulkner said that Dr. Werner was the first engineer in Germany to earn the distinction of Doctorate, whilst his Association was the oldest employers' federation in Germany. Dr. Werner had been President for some 23 years, and the highest honour a foundry metallurgist could receive in Germany was the receipt of the Werner Medal. The German Foundry Owners' Federation counted amongst its members no less than 90 per cent. of the 2,000 foundries in Germany. Its activities covered liaison with the other employers and technical associations, the organisations of Exhibitions, unified costing, large-scale co-operative research, co-operative buying and personnel recruitment and training. The British foundry industry was indebted to the Doctor for his willingness ever to help in any matter, either international or national, respecting the progress of the foundry industry.

Dr. Werner, in reply, referred to the warmth of his reception in London, of which he was deeply appreciative. He dealt with the steps his Association had taken to achieve a reasonable and equitable price for the product of the ironfoundry, and outlined the methods undertaken to assure themselves of raw materials at a reasonable figure.

Mr. Wesley Lambert (President of the Institute of British Foundrymen) proposed the health of the Chairman, to which Sir Robert Donald, in reply, recalled with pleasure his protracted visits to the Ruhr during the French occupation as a special correspondent.

Publication Received.

Aluminium Foundry Data. Published by The British Aluminium Company, Limited, Adelaide House, King William Street, London.

The service which the British Aluminium Company gives to the foundry industry through its brochures is very much appreciated by its executives. They are rightly regarded as valuable text-books. The one under review, No. 328, has superseded No. 313. After providing the reader with a contents list, the scheme followed for the opening has been to tabulate all the physical data available on metallic aluminium, then to illustrate in detail the forms in which the raw material is available, and to conclude with a mass of interesting data about the more common alloys cast in the foundry. To accomplish this, British Standard Specifications of aluminium alloys are detailed, and are followed by descriptions of Al-Si, Al-Cu and Al-Cu-Zn, and "Y" alloy. The second section is devoted to some 16 illustrations destined to convey a comprehensive view to the founder of the great potentialities of his section of the industry. The final section—Shop Practice—carries the reader from melting furnaces, through the subjects of pouring temperature, mould confection, gating and chilling, knocking out, to the dressing of the finished castings. Then such subjects as annealing, heat-treatment, machining, grinding, welding, polishing, frosting, scratch brushing and sand blasting are successively dealt with. The light-alloy founder can deem himself fortunate that this publication is placed at his disposal free of charge on application.

Catalogues Received.

Dust Removal.—We feel that we could not do better than quote the introductory remarks of Catalogue K 189, recently issued by Messrs. James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.4, as it crystallises modern enlightened opinion on dust removal:—"Of recent years, increasing attention has been paid to the question of dust removal, both by manufacturers and Government Departments, and progressive manufacturers realise that it is a paying proposition to install efficient plant to collect dust the moment it is produced and before it has time to permeate the surrounding atmosphere. The general experience of users of up-to-date dust-removal plants is that, under the healthier conditions thus promoted, more work and better work is done; whilst the reduced wear-and-tear on the machines, shaft bearings, etc., and the reduced expenditure for sweeping up and general maintenance of workshops represent sources of direct economy."

We can add to this that in many cases there is a distinct reduction in the lighting bill. Again, in some case, such as firebrick-dressing machines, clean dust is valuable. To present their contribution to industry and to expose the type of service they give, this firm has used a 24-page well-illustrated booklet, uniform with their other publications. As this problem of dust collecting affects the majority of foundries, they should certainly add this brochure to their files.

C.I. Syphons.—The Northgate Ironworks Company, Bury, St. Edmunds, Suffolk (proprietors, Robert Boby, Limited), have illustrated, tabulated and priced details of the Horseley Syphon on the back of a blotter, which is available to readers on request.

Protective Products for Industry.—Messrs. S. Pulzer & Son, Limited, of 45, Hatton Garden, London, E.C.1, have sent us a collection of the trade literature published by their principals, Messrs. Wilson Products, Inc. Of these, No. 29 is the most comprehensive. The first six pages illustrate and describe six models of fettler's goggles. The foundry industry is next appealed to on page 10, which details a special type of grinder's spectacle. From page 15 to the end of brochure, which contains 32 pages, the whole of the contents are of special interest to foundrymen, welding goggles and shields, sand-blast helmets and dust respirators, are each outlined in turn. Although the catalogue has not been specially designed for the foundry industry, about three-quarters of its contents are of supreme interest to our readers.

Junior Foundrymen Hold Annual Social.

The Junior Section of the Lancashire Branch of the Institute of British Foundrymen was held last Saturday at the St. George's Café, Manchester. Amongst the guests present were Mr. R. A. Miles, President; Mr. A. Key, vice-president; Mr. T. Makemson, general secretary and past president; Mr. W. Jolley and Mr. R. W. Stubbs, past presidents.

Tea was partaken by some 100 members and friends, after which a whist drive was held. The remainder of the evening was devoted to dancing and an entertainment given by Mr. Tom Jackson. All the members present felt the function to be an entire success, and certainly it plays a great part in the social side of the Section.

Random Shots.

I read the other day of a "secret mission" that has been investigating conditions in the steel industry on the Continent for the benefit of the Sankey Committee that was appointed last July to inquire into the iron and steel trade in Great Britain. My authority seemed a little shaky about the whole thing, and admitted that the mission "went privately and made its own arrangements," but I pass on the idea for what it is worth. An adequate investigation into the iron and steel industry in this country might very well involve some comparison with Continental methods, and such comparison would necessitate direct and specific investigation of "steelworks, blast furnaces and rolling mills"—(I quote again)—"in Germany, France, Belgium and Czecho-Slovakia." Moreover, those of us who know anything at all about Continental conditions would be in no way surprised to learn that "methods of manufacture were found to be in many ways in advance of those common in Great Britain, and labour-saving machinery is in much wider use." While it needs no secret mission to prophecy that evidence from the Continent would be in favour of large-scale reorganisation . . .

* * *

And talking of the Continent, that reminds me! I must apologise for reverting to a subject that I have already—and a trifle prematurely—discussed at some length; namely, the eating of peas. But a valued correspondent—one who has before now been moved to display a positively touching interest in the correctness of my information—a valued correspondent, I repeat, writes to tell me of the latest development in pea-eating on the Continent, and I cannot in the interests of humanity keep the knowledge to myself. It appears that Herr Geheimrat Dr. Dipl.-Ing. Sauerkraut, after a lifetime of study, has succeeded in producing a square pea, which, as may easily be imagined, presents no difficulty whatever in manipulation, even with an ordinary knife. My informant adds that it is found less expensive to cultivate these square peas than to design and manufacture special knives for pea-eating. Surely we have here another case of unrecognised genius; for—I blush to record the fact—I had never even heard of Dr. Sauerkraut's work before!

* * *

If you hear rumours of over-lavish equipment in the foundry trade, they will probably owe their origin to this little story. Imagine two ironfounding firms side by side: one decides to erect a new foundry, and the personnel of the other watches the proceedings with great interest. Moreover, the new foundry is to incorporate a very special ventilation system, giving from the outside the appearance of a number of cupolas. Result: Awed comments from the onlookers, to the following effect:—Monday: "They got the first cupola up!" Tuesday: "Lumme! Twenty-four cupolas!" Friday: "Blimey! There's a cupola for every moulder!"

* * *

A variation on the racial theme in yarns is the following:—An Irish priest, instructing a class of boys, offered sixpence to whoever could name the greatest man in history.

"Napoleon!" suggested one. "Carnera!" volunteered another. "St. Patrick!" said a small Jewish boy.

He won the sixpence, but before he went home the priest took him aside and asked why he had named St. Patrick.

"In my heart I know it is Moses," said the boy, "but business is business!"

Marksman.

Recent Research on Moulding Sands.

At a recent meeting of the Sheffield Section of the Institute of British Foundrymen, held at the Albany Hotel, Sheffield, MR. C. PRESSWOOD gave a Paper (previously published in this Journal) entitled "Recent Research on Moulding Sands." There was an interesting discussion.

Discussion.

MR. G. L. OXLEY (Branch-President), who presided, opened the discussion by referring to the permeability of sands. He said that in the case of ingot moulds where they were casting with very soft iron, there were many times when they had a scab at the corner. As far as he had been able to make out, the only way of overcoming it was by ramming those corners harder, and in doing that they were reducing the permeability, and yet they were doing away with a scab in the corners. He noticed in one table shown by Mr. Presswood that the Mansfield and Worksop sands were both at the maximum strength with 5 per cent. of water. He would have been inclined to think the Mansfield sands needed more water than the Worksop sands.

MR. E. G. CRAWLEY said Mr. Presswood had made comment in regard to the lime content in a moulding sand in that should it exist in the bond it would be detrimental, but existing as grains of felspar it would not be detrimental. He (Mr. Crawley) had been led to believe that lime would only be safe if it existed as grains of the carbonite or dolomite or the like. One other thing which had interested him was the statement that the permeability of a moulding sand was reduced as the water content was increased. He had always been under the impression that loam work was more permeable than dry-sand work, but Mr. Presswood's figures showed that this was not the case.

MR. J. G. A. SKERL (B.C.I.R.A., Sheffield) said that there were one or two points he would like to raise, especially from what one might call the more practical standpoint. Had Mr. Presswood any information as to the comparison of the results he had given on the raw sands with actual foundry mixtures? Could he state, for example, whether the permeability and strength of foundry mixtures varied with the amount of water to the extent that they did in new sands? He asked this because he himself was examining this actual mixture at the present time, amongst his other activities. The question of milling was a very important one, and was one which he was glad to say foundrymen were taking very much to heart. The old-fashioned type of edge-runner mill with heavy rollers was not designed for foundry purposes. The heavy rollers crushed the grains of sand, whilst there was evidence that much of the trouble due to scabbing was due to lack of attention to the principles which should guide good sand-treatment practice. The present movement towards the use of lighter rollers which did not rest on the bottom of the pan was leading to better results in the foundry. Referring to the question of blue skin on castings, moisture had undoubtedly a great part in the attainment of this much-desired appearance, and was certainly a factor which had to be controlled if consistent results were to be obtained. Coal dust, amongst other factors, had a certain bearing on this problem. The question of lime in moulding sands was one of minor importance. There were two schools of thought on this problem, one regarding lime as definitely harmful, and the other, which averred that it had little or no effect. To the speaker it would appear that much depended on the form in which the lime existed. For most iron castings, if it existed as felspar or as grains of calcite, little harm would arise, but if it existed in any appreciable amount in the bonding materials it was far more dangerous. For steel-foundry sands the case is different.

MR. H. S. MOORWOOD, speaking as an old foundry "hand," thanked Mr. Presswood for his interesting Paper, and said that some of the best practice in steel castings in the country, from his knowledge, incorporated as pure a silica sand as could be got without any of the questionable elements such as are contained in aluminous. They added to this sand a known quantity of artificial bond sufficient for the desired purpose. In the case of water, they eliminated it and then added a known quantity. One could sometimes illustrate a point by analogy. The Bessemer process of making steel was to eliminate, by blowing, most of the elements contained in the raw pig-iron, good or bad, and then add the required quantity of carbon, the product being of the exact composition required. It enabled the steelmaker to be independent of expensive brands of iron which had hitherto been essential in the making of steel.

In some of the most prominent steel foundries he knew they were using as pure a silica sand as they could get without any regard to its natural bonding properties, then adding a known quantity of artificial highly-refractory bond, so that the sand did not depend upon alumina or any other constituent.

MR. F. E. STEELE said foundrymen generally were at the mercy of the materials delivered to them, especially in the way of sand. One receives a consignment of sand very much different in moisture content from another, this being due possibly to inclement weather. Then there was the difficulty of the moisture content immediately. Every firm was not in the position to use the best possible means as advocated by Mr. Presswood, for the foundryman was left to use his own resources and means of overcoming the difficulty. With reference to getting a skin on the casting, it had been suggested, of course, that one could get a certain fine skin on an iron casting by the degree of cooling, but in doing so one was apt to chill the surface of that casting, and, if it had to be machined, very often it was a disadvantage. He was wondering whether Mr. Presswood could give them some mixture of sand that would materially help in the formation of that blue skin which was so much desired by most founders.

AUTHOR'S REPLY.

Replying to the discussion, MR. PRESSWOOD said, in the first place, he mentioned his general attitude. He held that scientific investigation followed practice. Although there were many inventions and many wonderful things made up their ordinary present-day life, they were deduced from fundamental principles. He felt that in most cases scientists were following practice and trying to explain what the practical man had already discovered. They did much work which was not necessarily going to prove anything new. His view was that, if permeability was important, it was of interest to examine on a small scale what was the effect of moisture and milling on permeability, and see if it had any bearing on their results. It was interesting to try and support some definite conclusions already reached by the practical men. They might go further and find the fundamental principles. He would be the last to say they could specify a sand on the strength of the figures indicated, but he thought the study of some of those points had led definitely to the conclusion that it was perhaps best to start with pure materials. It was only by close laboratory inquiry that they would be able eventually to synthesise those sands. It was no simple matter and not sufficient simply to mix the clay. For instance, there was a most peculiar property of some of these artificially-bonded mixtures. They appeared to dry rather differently from the natural sand. The surface might appear to be more friable. They could show that, by doping their bond clay in very tiny proportions of other chemicals, they could get an increased strength. By other doping they could definitely improve its dry strength and prevent friability. Mr. Presswood added that he could not explain Mr. Oxley's question. Referring to other questions, Mr. Presswood said he agreed that they should start with the purest possible sand they could get. In mentioning lime during the lecture he probably did not make the point quite clear. If they said 2 per cent. was not seriously detrimental, they should not rush to the conclusion that they could dilute clay with 20 per cent. calcium oxide with nine parts of silica sand and have a resulting mixture showing only 2 per cent., expecting that to be a satisfactory mixture. Mr. Skerl asked him (Mr. Presswood) whether he could relate much of the principles outlined to practice. He had observed that foundries which very carefully removed the silt from the floor sand had better results than they would otherwise. That practice definitely supported some of the points he had mentioned.

He had tried to suggest that the question of the blue skin was by no means simple. He felt that they did not get a perfect blue skin without good stripping qualities in the sand. If they had good stripping qualities, then the blue skin varied with the rate of milling.

A good deal of reference had been made to the question of pure materials and the variations in natural resources. If foundrymen insisted upon pure materials, free from variation, they must realise that, even if they were agreeable to pay the high price for them, deposits of suitable sands were very scarce.

Additional expenditure in the treatment of floor sand and the blending of sand in foundries themselves had certainly paid for itself. He did not think it was necessary to say any more about the variations. Sands did vary, and, when one had a knowledge of geology, one wondered that they had the uniformity they had.

Proposing a vote of thanks to the lecturer, MR. SKERL said that, whilst he always appreciated Papers on moulding sands from those who attacked the subject from the scientific standpoint, he would be very much more pleased if the practical men would come forward and give their views and experiences. The speaker was in a position to obtain their point of view by personal contact, but permanent record was required, and he suggested that it would be a good thing if the Branch made a definite point of having such a practical Paper on its agenda every year.

Applications for Trade Marks.

The following list of applications to register trade marks is taken from the "Trade Marks Journal":—

"DORMAL."—Aluminium alloy castings. W. H. Dorman & Company, Limited, 43, Foregate Street, Stafford.

"KARMA."—A nickel-chromium alloy. Driver-Harris Company, c/o White, Langner, Stevens, Parry & Rollinson, 5 to 9, Quality Court, London, W.C.2.

"AJAX."—Pig-iron. Lander & Larsson, Limited, 164, Edmund Street, Birmingham.

DEVICE, including the words "British Steel."—Steel manufactured in the United Kingdom. The National Federation of Iron and Steel Manufacturers (Corporate Organisation), Limited, Caxton House (East), Tothill Street, London, S.W.1.

"JACOL."—Steel. Société Anonyme Etablissements Jacob Holtzer, c/o Arthur H. Greenwood, 39, Bank Street, Sheffield.

Gary Medal.—The American Iron and Steel Institute medal, one of two medals founded by American Iron and Steel Institute to commemorate the great services rendered by the late Elbert H. Gary, its founder and first president, to the iron and steel industry, has been awarded to Dr. Elmer A. Sperry for his Paper, "Non-Destructive Detection of Flaws," this being the first award of this medal.

High-Quality Cast Iron for Cylinders.

Mr. F. J. Cook, Past-President of the Institute of British Foundrymen, addressed the members of the West Yorkshire Branch on March 1 at the Bradford Technical College, Mr. W. G. Thornton (Bradford) presiding. Mr. Cook's talk, illustrated by lantern slides, was given impromptu, but covered the ground of the lectures he gave to the London and Newcastle members of the Institute and summarised in The Foundry Trade Journal of March 1, 1928.

The President said Mr. Cook was one of the founders and one of the most valued workers in the Institute of British Foundrymen. He was widely known by repute to a great many who had not met him personally, and he felt he was a man who needed little in the way of introduction to an audience of foundrymen. They could be quite certain that what he had to say would be well worth hearing.

Mr. Cook said his talk was based on an experience of foundry work going back 40 years. He showed pictures of the making of parts of cylinder engines for marine purposes, high-speed machines for electricity generation, etc., with particular reference to the foundry work involved and the question of structure and tensile strength. He showed also on the screen various tables and formulæ, which he felt might be informative to any interested in the making of high-duty cast iron for steam, Diesel and compressor cylinders.

Discussion.

Phosphorous in Diesel Engine Parts.

The President, in opening discussion, said he would like to correct Mr. Cook in one little detail. Mr. Cook had spoken of the making of a core which he believed to be the largest ever made in England. That was not quite correct, as Mr. Thornton knew of a larger one—but of loam—which was made in Bradford. Turning to the matter of phosphorous content, the President said his own experience when he started doing work for Diesel engines, pistons, etc., was that they had to get phosphorous down in order to avoid the evil of star cracking. He remembered one instance in which every piston they made cracked, and the phosphorous in the piston heads in that batch was 0.7 per cent. The composition was based on Mr. Cook's own well-known silicon-carbon formula. They then reduced the phosphorous under 0.5 per cent. and the trouble was remedied, and he believed the pistons produced were still working. Since that experience, however, he had always kept the phosphorous below 0.4 per cent., and he had never been troubled with cracked pistons since. Mr. Thornton said he would like to endorse Mr. Cook's remarks on the formula he had shown on the slide and to which he had made considerable reference. Up to two or three years ago he (Mr. Thornton) was engaged in a similar line of work to that of which Mr. Cook had been speaking, and in that work he regarded that particular formula as his sheet anchor. Any member who had tests to make would not go far wrong if he worked within those limits. But so far as concerned phosphorous, he felt that that was a rather debatable matter, and he thought it was rather good advice to people to be guided largely by their own experience. In regard to manganese, personally he always liked to work a little higher than Mr. Cook had suggested. It would be interesting to know if Mr. Cook had ever found any difference in test in regard to the position of the test-bar? That, of course, depended largely on the particular irons being used.

Variations of Phosphorous Content.

Mr. Cook, replying, said he was by no means advocating high phosphorous. He was merely showing that within the range of that silicon-carbon ratio phosphorous was a thing one could very nearly ignore, within quite wide limits. Mr. Thornton was quite right in saying it was wise to keep phosphorous below 0.5 per cent. for Diesel work. In regard to denseness, in his talk he ought to have mentioned a point which was rather startling to him at first—that where the densener was, the material was softer than the other part. The wear of a cylinder depended on a metal having good body in it and a metal which would polish quickly. In regard to the manganese, his remarks on manganese in the talk were governed by the fact that he was using denseners. He was not a believer in abnormal manganese, because an iron with an abnormal manganese was very spiky. Anything that retarded the good cooling down of the mass affected its strength. That was a matter that must be controlled. One would not put a test-bar in a furnace to heat it up to get the best results. In a further reference to phosphorous, Mr. Cook remarked that phosphorous had a tendency to reduce the total carbon and the pearlite tended to be finer and sometimes tended to be granular.

Physical Results Differ with Same Analysis.

Mr. W. H. Poole (Keighley) said the phosphorous question seemed to be still a very debatable one. Mr. Cook had mentioned that on one or two occasions with the same analysis he had got different results, and it would be interesting if he could state what were probably the causes of the difference. The lecture had been extremely interesting in giving the members an opportunity of seeing and appreciating the methods used by Mr. Cook in early days, and they were certainly fortunate in having one of the pioneers of scientific founding to tell them something of his trials and the manner in which he had overcome them. In regard to phosphorous, Mr. Poole said it was true that the higher the phosphorous generally the lower the total carbon. It would be interesting if Mr. Cook could give his opinion as to the influence of phosphorous in cast iron in the matter of growth of iron. Mr. Poole thought high phosphorous in a Diesel metal was not advantageous from that point of view, though he could appreciate that high phosphorous may be beneficial in regard to wear. In discussing the influences and effects of any one element—as in this case of phosphorous—they had to remember, of course, that all other elements must have an influence in controlling the factors also. Perhaps Mr. Cook might care to go into a little more detail as to how he controlled the network of the iron. It was very interesting to have heard Mr. Cook speak of irons so long ago where he got 3 per cent. of total carbon. In regard to manganese, Mr. Poole said Mr. Cook appeared to favour low manganese conditions, assuming, presumably, that he had properly balanced the sulphur. Mr. Poole said he found in light castings work that one obtained an intense chilling effect with a high manganese iron, particularly with a high phosphorous iron, and one could agree that by controlling the manganese, if the sulphur were controlled, one could cast a very thin iron. It would be interesting to have Mr. Cook's opinion of the effect for Diesel work with regard to wear, if the silicon were kept low and the phosphorous low, as compared with the higher phosphorous and the lower silicon metal.

Phosphorous and Growth of Cast Iron.

Mr. Cook, replying to Mr. Poole's question as to different physical results from the same analysis, said that was a matter dealt with at some length in the Proceedings of the Institute of British Foundrymen of 1908-09. The only explanation he had found is the way in which the iron had been made in the blast furnace. It depended largely, apparently, on the speed of working of the blast furnace. Slow-running furnaces gave the best irons. On the other hand, going to the other extreme, and, for instance, the American irons, one obtained about the worst iron. In regard to the network structure, Mr. Cook said he was of opinion that it was due to the way in which it had been made in the blast furnace. In answer to the question as to phosphorous and growth, Prof. Sir Harold Carpenter had done much work in that matter of growth; and in answer to a question which he (Mr. Cook) had put to him, Sir Harold had distinctly stated that it did not affect the growth in temperature. One knew that phosphide eutectic did sweat out, but within reasonable temperatures such as they had to use for cylinders, he (Mr. Cook) had never found difficulty in that respect. Phosphorous did aid work if it was within that structure. In further regard to the control of the network, he would add that this could not be controlled once one had got one's iron. Mr. Cook said his 3 per cent. carbon was helped by the fact that he had a high total phosphorous. The usual mixture would come out at 3.2 per cent., but by a high blast pressure—which he did not recommend to the average man beginning on this class of work—they could get by mechanical action the removal of as much as 0.2 per cent. without losing silicon. The only fault he could find with bad samples of cylinders was that they were abnormally high in manganese. With regard to the chilling action of manganese on light castings, they were—as Mr. Poole had said—certainly liable to trouble straight away. The graphitising action would be impaired and the manganese would act as a direct hardener. In regard to wear, that was a rather awkward question. What one wanted was an iron which had "body" in it, but would "butter down" rather than break off. Generally speaking, from the point of view of wear, he (Mr. Cook) liked a fairly high phosphorous. Where he had not to stand high temperatures he would recommend 0.7 to 1 per cent., particularly if the cylinders were complicated when the question of contraction was likely arise.

Vote of Thanks.

Mr. H. Sayers (Leeds), Senior Vice-President of the Branch, proposed a vote of thanks to the lecturer, which Mr. R. D. Welford (Bradford), seconded, paying tribute to Mr. Cook's enthusiasm in having risen from a bed of sickness to travel from Birmingham to Bradford to give his lecture. One interesting point on which Mr. Cook had given some valuable enlightenment that evening was a correction of a widely-held impression that the denseners would harden the metal in their immediate vicinity. The vote of thanks was carried with acclamation.

Contracts Open.

Belper, March 31.—1,200 yds. of 9-in. cast-iron water main, for the Belper Urban District Council. Mr. F. W. Hodson, consulting engineer, Bank Chambers, Loughborough. (Fee £3 3s., returnable.)

Birmingham, March 29.—1,400 tons of grooved steel girder tramway rails, and fishplates, for the Corporation. Mr. A. C. Baker, general manager. Council House, Birmingham.

Coventry, April 14.—Pumping machinery, for the Corporation. Sir A. Binnie, Son & Deacon, Artillery House, Artillery Row, Westminster, S.W.1. (Fee £10, returnable.)

Howth, Ireland, March 29.—Water mains and pumping plant, for the Urban District Council. Mr. F. Higginbotham, engineer, 3, Clare Street.

London, S.E., April 9 and 16.—596 tons of mild-steel sheets and bars and 90 tons of laminated spring steel, for the India Store Department, Belvedere Road, Lambeth, London, S.E.1. (Fee 5s., non-returnable.)

London, W., April 4.—Iron and steel stores, for the G.W.R. The Stores Superintendent, Swindon.

Gases in Copper and their Removal.*

By W. E. Prytherch,[1] M.Sc.

It has been realised for some time that unsoundness in metals may result from two causes, which may operate either simultaneously or independently: (1) Contraction cavities, due to the decrease in specific volume of a metal which occurs on solidification; (2) blowholes. This work is concerned only with the latter form of unsoundness.

Sieverts[2] has found that molten copper can dissolve a considerable quantity of sulphur dioxide and a smaller quantity of hydrogen. In each case the solubility is proportional to the temperature and the square root of the partial pressure of the gas. His results are graphically illustrated in Figs. 1 and 2. From Fig. 1 it will be seen that hydrogen is soluble both in liquid and solid copper, and that a sharp discontinuity occurs in the solubility temperature curve at the melting point of the metal, the solubility decreasing with solidification.

It is probably on account of this sudden evolution of gas that copper, containing hydrogen in solution, when cast, will give rise to a blown ingot. It will be evident, therefore,

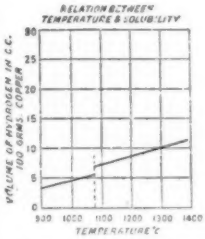


Fig. 1. Solubility of Hydrogen in Copper (Sieverts).

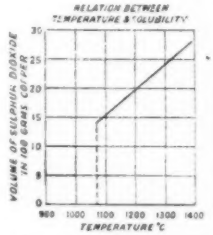


Fig. 2.—Solubility of Sulphur Dioxide in Copper (Sieverts).

that the exact condition of the solidified ingot will be a function of the conditions existing during solidification and the duration of the process of solidification.[3] A typical ingot produced from copper containing large quantities of dissolved hydrogen is shown in Fig. 4. It will be seen that the ingot has risen considerably in the mould, and is characterised by unsoundness, and consequently, low density value.

The effect of sulphur dioxide is somewhat more complicated. In order to observe its effect, 10 lbs. of cathode copper were melted in an electrically-heated crucible furnace, which maintained a slightly reducing atmosphere. When the metal was molten, sulphur dioxide gas was passed through for ½ hr. and the metal was then cast into a cast-iron mould which had been previously heated at 150 deg. C. A small amount of gas was liberated during solidification, but in spite of this no rising in the mould occurred. A macro-examination of a section of the ingot revealed the presence of blowholes differing in shape and distribution from those resulting from the passage of hydrogen. The appearance of a section of the ingot is shown in Fig. 3.

C. M. Stubbs,[4] in discussing Sieverts' results, relating to the influence of pressure on the solubility of sulphur dioxide in copper, considered that the facts can be explained on the basis of the balanced reaction:

$$6Cu + SO_2 \rightleftarrows 2CU_2O + Cu_2S.$$

"It is found," he said, "that the depression of the freezing point of copper is 2.54 times as great as it would be if the molecules remained unchanged on going into solution." Thus, the behaviour of sulphur dioxide in molten copper will depend entirely on the conditions prevailing *i.e.*, whether the conditions are oxidising, reducing, or neutral. Under reducing conditions the tendency would be to form Cu_2S, while under the influence of an excess of Cu_2O more sulphur dioxide gas would be formed. There are no data available as to the solubility of sulphur dioxide gas as such in copper, so that the part played by sulphur dioxide in the production of blowholes cannot be estimated. The ingot shown in Fig. 3 was produced under slightly reducing conditions. The character of the ingot would, no doubt, be considerably modified by its preparation under other conditions.

In order to study the effect of dissolved hydrogen on cast copper, a number of experiments were carried out by the author at

Fig. 3.—Effect of SO_2 (Casting Temperature 1,270 deg. C.).

with barium chloride. The casting temperature was 1,150 deg. C. Considerable evolution of gas took place during solidification, causing marked rising of the metal in the mould. The ingot was found to have a low density (Fig. 5).

(2) In this experiment the cathode copper was melted under a layer of charcoal and cast into a chill-mould. The ingot rose considerably in the mould. A section of the ingot is shown in Fig. 6.

(3) The same weight of copper was melted without any covering whatever. Oxidation could not occur owing to the melting being conducted in a reducing atmosphere. The ingot obtained is shown in Fig. 7. The rising in the mould was slight and less than in the two previous instances.

From these experiments it can be seen that the amount of hydrogen retained by the metal during melting depends to a large extent on the conditions of melting, such as exposure of the surface of the metal. When a flux is used the evolution of gas is prevented to a large degree, giving rise to unsatisfactory ingots. The use of carbon covering also prevents evolution of gas, probably by hindering diffusion and keeping a layer of hydrogen over the metal—the partial pressure of which will tend to keep the gas in solution.

Some experiments carried out to determine the effect of casting temperature on copper previously saturated with hydrogen at the temperature of casting, showed that the degree of un-

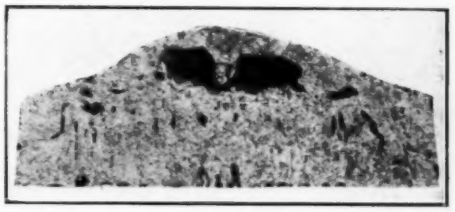


Fig. 4.—Effect of Hydrogen (Casting Temperature 1,270 deg. C.).

Swansea. Cathode copper was used throughout the experiments, and the majority of the melting was done in an electric furnace which maintained a slightly reducing atmosphere. Cathode copper contains appreciable quantities of hydrogen, arising from the manufacturing process. Some of this gas is probably in solid solution, but most of it probably exists in the occluded condition. During melting some of this gas will be set free or oxidised, the amount liberated depending on the conditions under which melting takes place, but the liberation of the gas is by no means complete during melting under reducing or neutral conditions. Cathode copper, therefore, when melted and cast under reducing conditions, will give rise to an ingot which rises in the mould and has the appearance of being considerably overpoled.

The following experiments show how the extent of this overpoled appearance varies under different melting conditions:—

(1) In the first instance, the conditions were such as to permit the copper to retain as much of the hydrogen in the original cathode material as possible. For this purpose a quantity of barium chloride was melted in a Salamander crucible which had been in use for some time. The cathode copper was broken up into small pieces which were pushed beneath the molten flux, care being taken that each piece was completely covered. It was observed that bubbles of gas were liberated from the metal during melting. When all the metal (10 lbs.) was melted, the barium chloride was thickened by means of sand—after the method adopted by Hanson, Marryat, and Ford[5]—to facilitate the pouring of the ingot without contamination

soundness increases with increasing casting temperature—an effect which can be attributed to two causes: (*a*) Increased solubility of the gas; (*b*) decreased rate of solidification, which will be shown later to have a profound effect on the density of the casting.

Effect of Rate of Solidification.

In order to determine the effect of varying the weight of the ingot, various weights of metal, which had had similar treatment during melting, were cast in a similar mould.

It was found that as the weight of the ingot was decreased the density of the ingot increased. From these results it can be concluded that the rate of solidification of the ingot has a pronounced effect on the density. This is probably due to the fact that if the solidification is slow the period of time during which the metal passes through the spongy stage is prolonged, and thus the dissolved gas has an opportunity of coming out of solution and becomes entrapped as blowholes in the metal. In the case of a severely chilled casting, however, the formation of blowholes is checked, owing to the metal becoming solid, and thus the gas may collect under pressure in the relatively small cavities formed and prevent further gas from coming out of solution. This explains why it is sometimes found that when treated *in vacuo* to remove the gas content the less sound ingot will give off less gas than an apparently sound ingot of the same material.

Fig. 8 shows the effect of weight of ingot on the density. It will be seen that the curve tails off. This means that if the weight of the ingot is increased still further, the density would not be correspondingly decreased. This, of course, only applies for the particular conditions used.

D

---

* A Paper read before the Spring meeting of the Institute of Metals. The research which forms the basis of this paper was carried out at the suggestion and under the direction of Prof. C. A. Edwards, D.Sc., at the University College, Swansea, for the British Non-Ferrous Metals Research Association.

1 Research Assistant, Department of Metallurgy and Metallurgical Chemistry, National Physical Laboratory, Teddington.

2 A. Sieverts, "Solubility of Gases in Metals and Alloys." Ber., 1910, 43, 893.

3 Sir John Dewrance has on frequent occasions drawn attention to this; some of the results of his investigations, carried out over a long period of years, are given in his Presidential Address to the Institute ("J. Inst. Metals," 1927, 37, 21-28). At the commencement of this research he gave much encouragement to the work by private communications and the presentation to the Association of an album of photographs illustrating his castings, made under widely varied conditions, to throw light on these phenomena.

4 C. M. Stubbs, "J. Chem. Soc," 1913, 103, 1445.

5 "J. Inst. Metals," 1923, 30, 205-206.

This is due to the fact that the rate of solidification is so slow that an appreciable amount of gas is given off which leaves the metal entirely before a crust is formed, preventing further evolution of gas.

Effects of Solidifying and Remelting.

The above experiments suggested that if the rate of solidification be sufficiently slow the greater part of the gas in the metal would be given off, and on remelting a denser ingot would result. In order to test this, further work was carried out.

Cathode copper was melted under slightly reducing conditions. When molten the crucible was withdrawn from the furnace and the metal allowed to solidify in the crucible, care being taken to agitate the surface with a carbon rod. During solidification large quantities of gas were evolved. The evolution took place in periods alternating between violent ebullition and almost perfect quiescence. The explanation of this behaviour probably lies in the fact that the solubility of the hydrogen is proportional to the square root of the partial pressure of the gas. When the crucible is exposed convection currents and draughty air blow away some of the iron mould. Ingots cast under these conditions were very sound and gave densities varying from 8.80 to 8.86, showing that vacuum melting was effective in rapidly removing the greater quantity of dissolved gas from the metal. Apparently this treatment is more effective with copper than with aluminium, since in the latter case the gas is only slowly evolved under these conditions.[6]

Effect of Oxygen.

Some preliminary experiments were carried out in order to determine to what extent hydrogen can be removed from copper by oxidation. From the following experiments it was evident that in the presence of molten copper an equilibrium is reached between Cu_2O and hydrogen, and the reaction to form water vapour is incomplete and occupies appreciable time.

In order to investigate this reaction a series of experiments were performed, in each of which 10 lbs. of cathode copper were melted in clay-lined Salamander crucibles, and various quantities up to the equivalent of 2 per cent. of oxygen were added in the form of CuO wire. The molten copper was then allowed to stand for 15 to 20 min. at 1,150 deg. C. and afterwards reduced back with charcoal under the reducing atmosphere of the electric crucible furnace.

The temperature of the metal was then adjusted to 1,150 deg. C. and the metal cast into a cast-iron mould. The density of the ingot was afterwards determined. The results obtained are given below:—

No. of ingot.	Oxygen. Per cent.	Density.
C_1	0	8.07
C_2	0.5	8.27
C_3	1.25	8.36
C_4	2.0	8.56

With a view to determining the time factor of the reaction, 10 lbs. of copper were melted as described above. When molten 0.25 per cent. of oxygen was added in the form of CuO wire and allowed to react with the molten metal for a fixed time, and then reduced with charcoal for 30 min. The metal was then cast as described above and the density of the ingot determined. The following results were obtained:—

No of ingot.	Time of oxidation. Min.	Density.
O_1	0	7.94
O_3	15	8.00
O_4	30	8.10
O_5	45	8.14

It was evident, therefore from these results that any attempt to remove hydrogen from copper by slight oxidation and subsequent reduction of the oxidised copper would not be completely successful, owing to the large excess of oxygen and the length of time required by the oxidation.

In the experimental work carried out above crucible melting only was under consideration, but even here the evidence has been to show that when heating was performed in such a way that gases containing sulphur dioxide and hydrogen were prevented from coming into direct contact with the molten metal, copper could be cast with much greater soundness and higher density.

The author wishes to express his appreciation of the interest, encouragement, and guidance of Prof. C. A. Edwards throughout the course of the work, and his thanks to the Council of the British Non-Ferrous Metals Research Association for permission to publish this Paper.

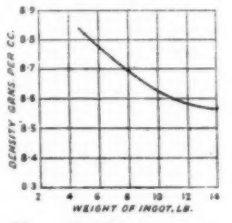


Fig. 8.—Effect of Weight of Casting on Density.

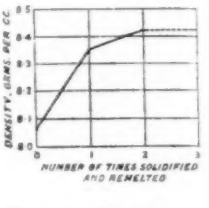
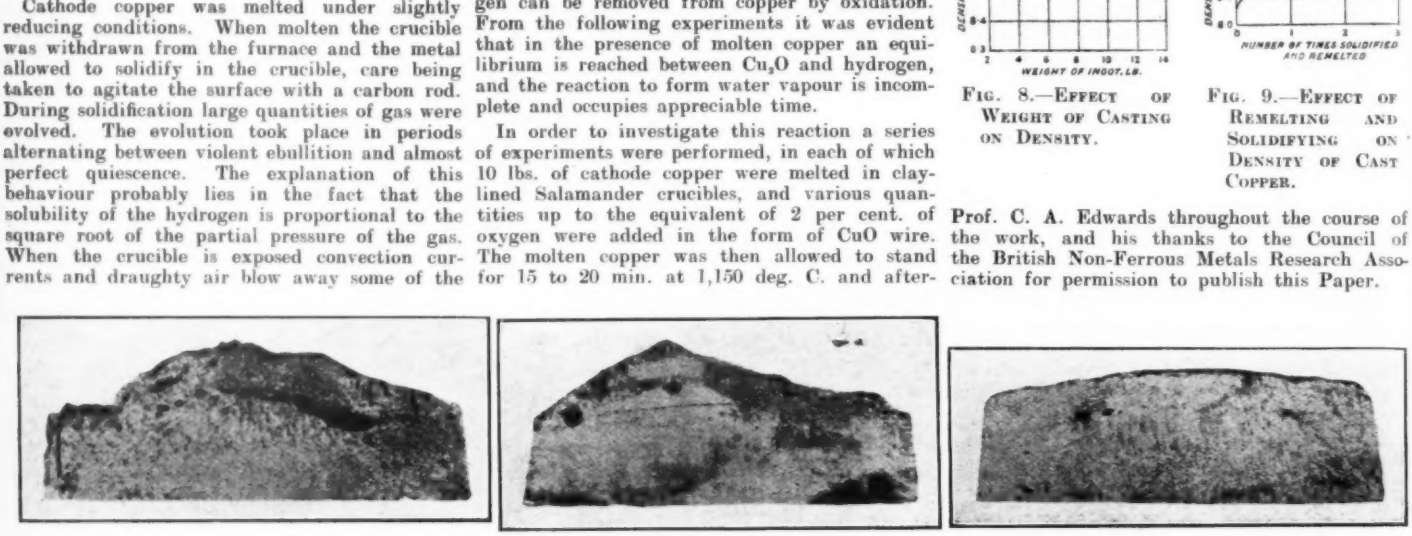


Fig. 9.—Effect of Remelting and Solidifying on Density of Cast Copper.



Figs. 5, 6 and 7.—Illustrating Ingots of Cathode Copper cast under varying Conditions. The Casting Temperature in each Case was 1,150 deg. C.

mantle of gas, and immediately rapid evolution of gas from the metal sets in and continues until the layers of gas above the metal surface again reach equilibrium. The phenomena are repeated until the metal begins to solidify.

When the metal was solid it was remelted as quickly as possible and cast. The resulting ingot gives a considerably higher density.[6] One repetition of the process gave still sounder ingots, but further repetition did not result in increased soundness. A curve showing the effect of the number of times of solidification and remelting on the density is shown in Fig. 9. It is highly important that the remelting should be carried out under conditions which will not allow undue absorption of gases.

Effect of Treatment with Inert Gas.

In the case of aluminium the passage of an inert gas, such as nitrogen, had been suggested by Rosenhain and found effective by Archbutt.[7] This method was itself tested out in the case of copper and found to be most effective. The metal was melted in a Salamander crucible, and, when molten, nitrogen was bubbled through for 15 to 20 min., using a graphite delivering tube. The metal was then cast into a cast-iron mould. Under similar conditions ingots gave densities of 8.84 when cast with, and 8.50 when cast without, the gas treatment; in both cases cathode copper being used.

Effect of Melting *in Vacuo*.

In order to determine whether dissolved gases were liberated from copper when melted *in vacuo*, 30 lbs. of copper were melted in a specially constructed electrical resistance furnace *in vacuo*, the vacuum being maintained by a Geryk vacuum pump. Previous to casting, the furnace was filled with nitrogen and the cover removed. The metal was then cast in a cast-

6 A similar effect was observed, and the pre-solidification method of removing gas was proposed independently and simultaneously by S. L. Archbutt in connection with work on aluminium alloy castings ("J. Inst. Metals," 1925, 33, 235).

7 "J. Inst. Metals," 1925, 33, 233-234.

8 *Cf.* Rosenhain, "J. Inst. Metals," 1925, 33, 244.

Reports and Dividends.

Thos. W. Ward, Limited.—Interim dividend on the ordinary shares of 3¼ per cent.

Motherwell Iron & Steel Company, Limited.—Loss for 1929, £9,111; debit balance carried forward, £43,230.

English Crown Spelter Company, Limited.—Trading loss for 1929 of £4,538, increasing the debit balance brought forward to £8,438.

International Aluminium Company, Limited.—Net profit, £42,619; brought in, £9,198; capital issue expenses written off, £15,847; to reserve, £7,500; carried forward, £11,235.

Coltness Iron Company, Limited.—Final dividend on the ordinary shares of 6 per cent., making 10 per cent. for the year; redemption and depreciation account, £53,500; to reserve, £35,000; carried forward, £120,410.

Rivet, Bolt & Nut Company, Limited.—Net profit, £34,393; brought in, £6,568; dividend of 8 per cent. for the year on the old ordinary shares and a dividend at the rate of 8 per cent. per annum on the bonus issue of 103,125 ordinary shares for the half-year from July 1 last; carried forward, £10,101.

British Aluminium Company, Limited.—Profit, including the amount brought forward, and after providing for taxation and setting aside £50,000 to depreciation reserve, £100,000 to the reserve fund and £10,000 to the staff benefit fund, of £153,637. Final dividend on the ordinary shares of 6 per cent., making 10 per cent. for the year, leaving £35,559 to be carried forward.

Welded Structural Steelwork.—In order to help the construction industry to obtain safe and economical structures, the U.S. Bureau of Standards in co-operation with the American Bridge Company has investigated welded connections for steel frame buildings. These included tests on column splices formed by welding plates to the inside faces of the column flanges. The connection was made by bolting splice plates to these welded plates. The tests showed that the connections were adequate in strength to carry the loads for which they were designed.—"The Iron Age."

Modern German Methods of Manufacturing Cast-Iron Baths and Other Sanitary Ware.

(*Continued from page* 213.)

Cleaning Operations.

In the fettling shop the coarse, loose sand is first of all brushed from them. Various methods are adopted for cleaning the baths in the fettling shop. Where production is comparatively small, the simplest way is to sand-blast the baths with a portable hose in an enclosed chamber, as shown in Fig. 8. The baths can be set up on a specially-designed holder, which can be swung over by hand to facilitate cleaning. It is also possible to sand-blast the baths by means of a hose in a chamber arranged as in Fig. 9. In this arrangement the baths to be cleaned are set up on a turntable revolved by hand and provided with a centre wall, so that the baths can be easily blasted inside and out with the hose. With this arrangement, one bath is being sand-blasted whilst the bath already finished is transported away by two other workmen and replaced by an unfettled bath. In this way it is possible

Fig. 8.—Fettling Chamber, with Hose for Sand-Blasting Baths.

for blasting to proceed continuously with very short intervals while the turntable is being revolved.

When producing on a bigger scale, it is advisable to pre-sand-blast the baths in a special machine with a grate conveyor table, as shown in Fig. 10. The baths to be fettled are slowly passed through the sand-blasting machine, with two of these special tables arranged in series, and subjected to the continuous action of four blast nozzles acting from underneath and four acting from the top. These blast nozzles are arranged so that all parts of the bath are impinged upon by the sand jet at a suitable working angle—an arrangement which enables the baths to be thoroughly cleaned. It is also possible to arrange machines of this type to operate mechanically, as shown in Fig. 11. With this type of sand-blasting machine the baths are conveyed by carriages under the blast nozzles, which, in this design, are arranged only at the top, and the baths must be turned round twice and passed through the blast for cleaning the inside and out.

The baths, pre-cleansed in this way by the sand-blasting machine, are then rubbed down, and, if necessary, slight fins or roughness are ground off. Before enamelling is performed, it is then necessary to roughen up the baths at the spots that have been pre-fettled and to blast them so that they are absolutely metallically clean. This work is best performed with a hose in a separate fettling chamber arranged as in Fig. 8 or Fig. 9.

The pickling of the castings prior to enamelling is a very important factor. Any sand grains adhering to the baths will probably give rise to blobs or blisters in the enamel; and rust particles set up dark patches which cannot be subsequently removed. The enamel also adheres better to a pickled surface.

Enamelling is carried out by applying a liquid paste of ground white enamel or other desired colour to the surface of the casting, this ground coating being stoved in at high temperature, as

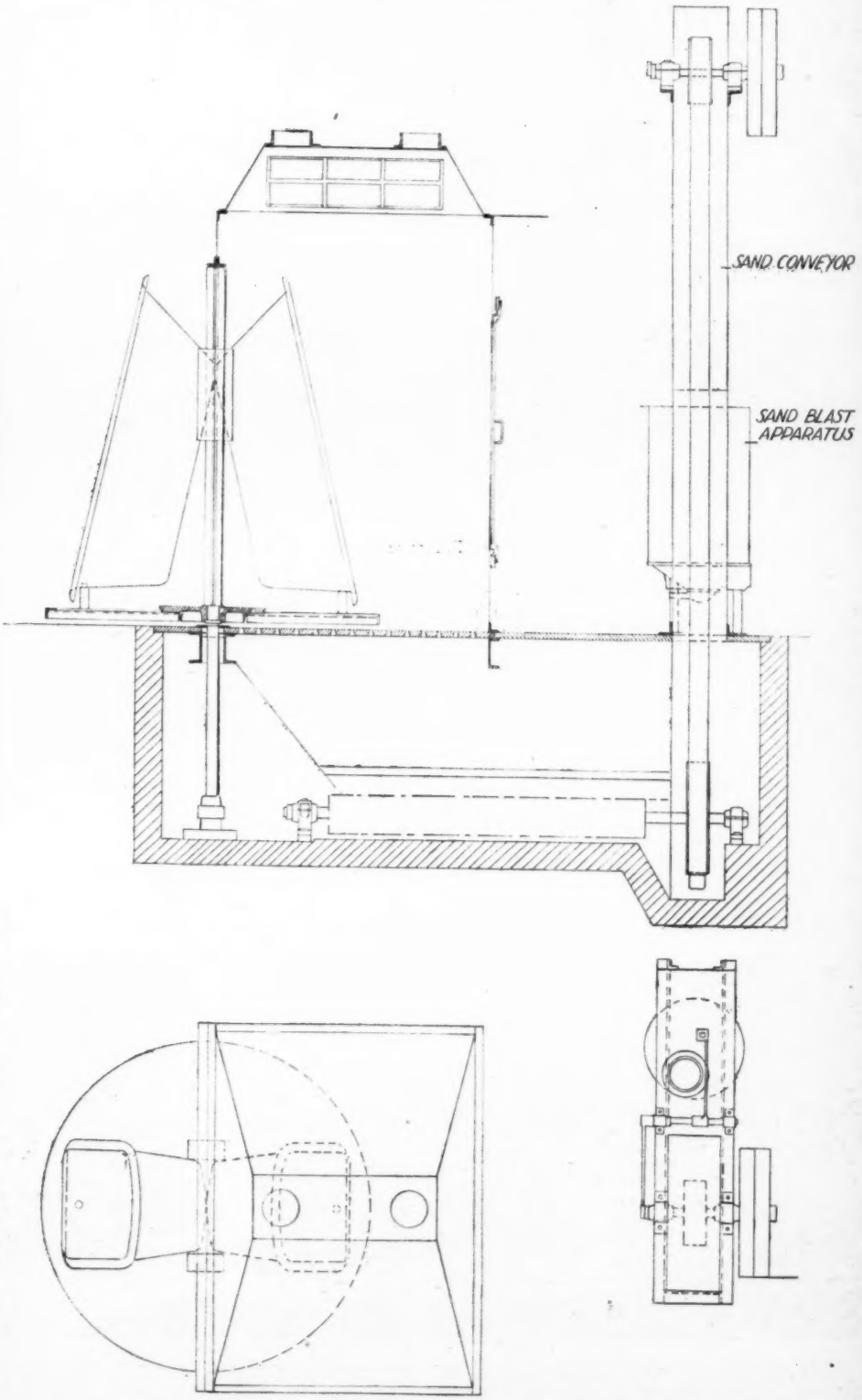


Fig. 9.—Fettling Chamber, with Turntable for Sand-Blasting Baths.

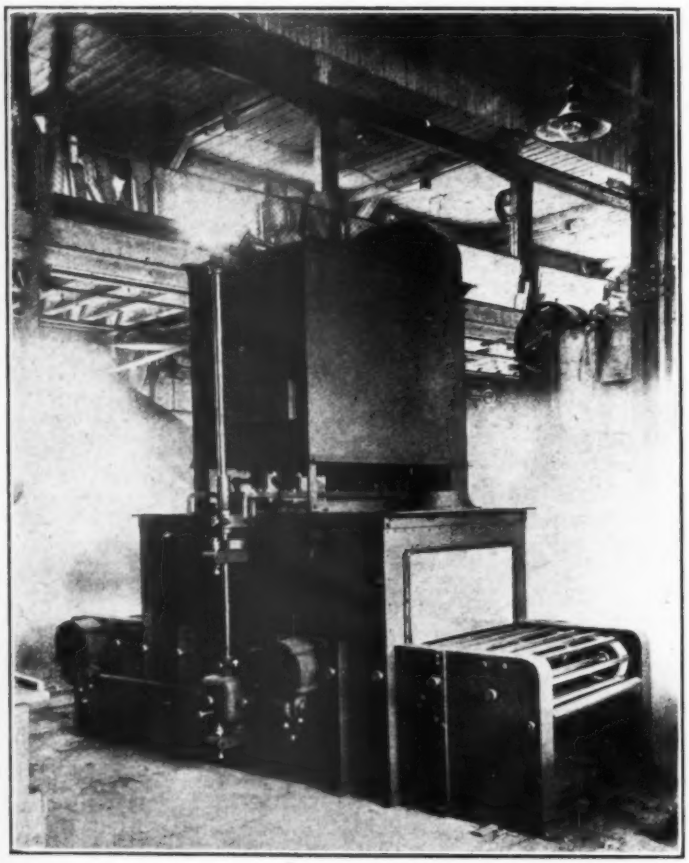


Fig. 10.—Sand-Blasting Machine for Fettling Baths.

Only after this procedure is it ready to be sifted or painted on to the bath. After careful drying the baths are conveyed by long iron forks to the enamelling stoves, which take the form of closed muffle furnaces, usually heated by gas. A swinging gear, as shown in Fig. 12, is normally used for enamelling the heated bath. The bath is placed on this gear, and, by turning a hand-wheel, swung over so that the powdered enamel can be sifted on to the more or less horizontal surfaces. Owing to the great heat, this is not a

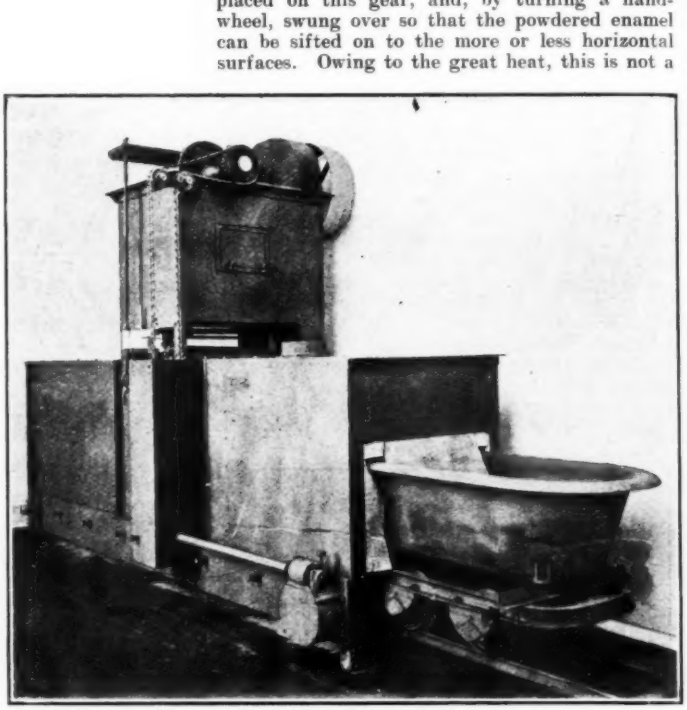


Fig. 11.—Bath Cleaning Machine.

it has a high melting-point. It consists mainly of pulverised quartz, borax, lime, kaolin and some magnesia. After the first coating of this enamel has been burnt on, the final white coating should be applied, consisting mainly of felspar, borax, tin oxide, magnesia, kaolin and ground quartz. This enamel is either sifted dry in powdered form on to the red-hot bath, or, like the ground base enamel, is blown on in the form of a semi-liquid paste. Both the first and second coating materials, after being separately mixed and ground to the consistency of dust, should first of all be fused in a crucible with a bottom opening, through which the melted enamel is overflowing into a water basin placed underneath. Then it is ground down to a fine powder.

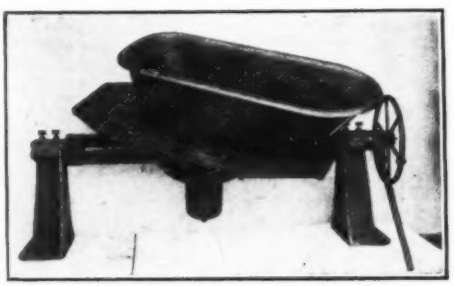


Fig. 12.—Swinging Table for Enamelling Baths with Powdered Enamel.

pleasant job, and one calling for a great deal of skill and practice.

Other Sanitary Ware.

The method adopted for the manufacture of many sanitary articles like wash-basins, sinks, W.C. flushing cisterns, etc., is similar to that outlined above, as the following description will show.

Wash-basins, or sinks with a back wall cast-on, must be moulded in a three-part moulding box, as the back wall usually has a reinforcing boss on it, and this does permit of the cod being raised vertically before the back-wall pattern has been removed. Two moulding machines are required, one of these being of the

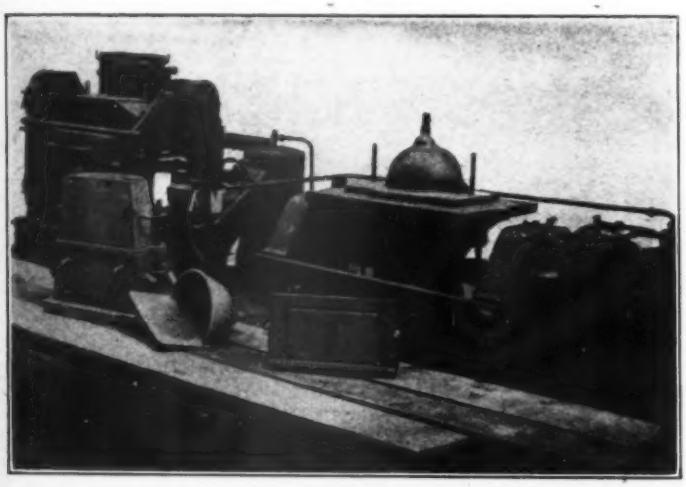


Fig. 13.—Moulding Device for the Production of Wash Basins. (Right) Pin Type Lifting Jolter; (Left) Turnover Machine.

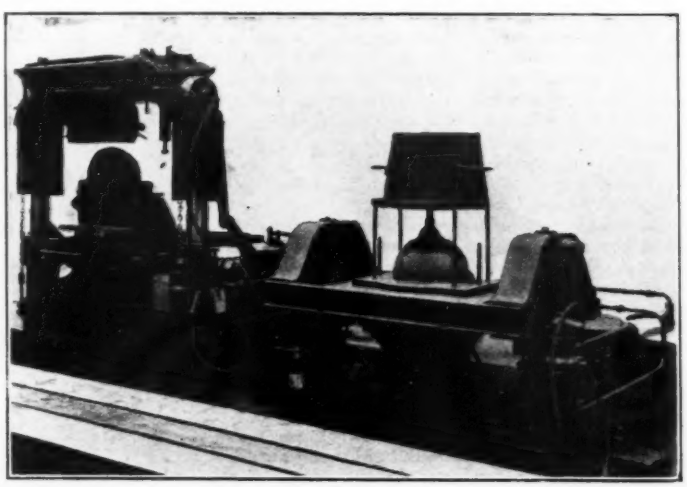


Fig. 14.—Moulding Device for the Production of Basins. (Right) Pin Type Jolter, with Box Raised; (Left) Turnover Type Jolter, with Box Turned Over.

direct-lifting type, and the other used as a turn-over moulding machine, and the pattern plate must be arranged so that the back wall can be mechanically separated from the pattern plate before the pattern is stripped. Figs. 13 and 14 show a plant of this kind set up on the test bed. In the foreground of Fig. 13 the completed casting is lying alongside the mould. The machines are of the jolter type, so that the sand can be consolidated without hand ramming in order to give clean castings of uniform weight. The machine shown on the right in Fig. 14 is intended for moulding the bowl, and the same Fig. 14 shows how the moulding box is lifted off. The moulds are jolted and the boxes raised by compressed air. The machine on the left is the turn-over moulding machine. After the mould has been jolted, the lifting gear raises the turn-over table, with the pattern plate for the cod of the basin resting in it, and turns it at the same time, so that the turn-over table assumes its highest position when turned through 180 degrees. The mould hangs downwards when this is being done. The turn-over table is then lowered until the moulding box rests on the carriage, and the clamps between the moulding box and the pattern plate are slacked off to allow the pattern plate to be lifted, as shown in Fig. 14.

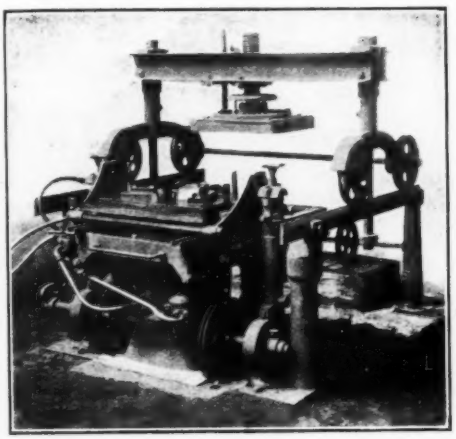


Fig. 15.—Turnover Jolter, with Squeezing Attachment, for Moulding the Cod or Drags of Flushing Tanks.

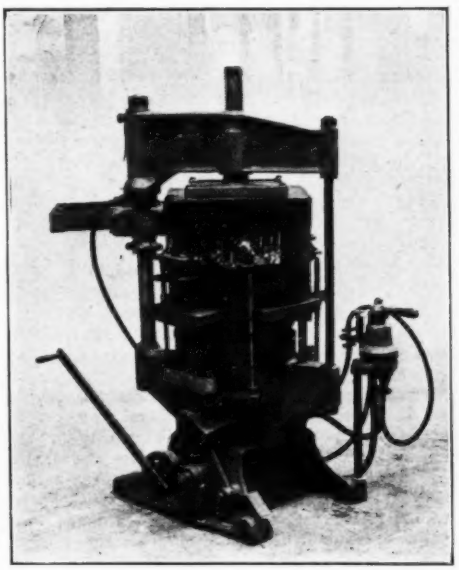


Fig. 16.—Jolter with Squeezing Gear, for Moulding the Cope or Shell Portions of Flushing Tanks.

The cod is now placed on the casting floor, covered by the top box, which has been moulded on the lift-off type moulding machine, and the back-wall moulding box pushed from the side against the assembled mould. The back-wall box is rammed by hand, as it contains very little sand. The output with two machines of the type described, which are tended by three workers, is 60 basins a day, casts of perfectly uniform weight being obtained.

Flushing Tanks.

The flushing tanks for W.C.'s, which also represent thin-walled deep castings, are also best produced on small jolters, to enable the sand to be rammed evenly and give clean and uniform castings. As a rule, flushing tanks can be produced on a small jolter with squeezing gear and turn-over plate, as shown in Fig. 15, whereas, for moulding the shell portions, a jolter with a simple lifting gear (Fig. 16) is used. These machines are of modern design, and are capable of turning out up to 40 moulds an hour with single patterns on the machine.

In the process of making tanks the sand is rammed by jolting and squeezing; that is to say, the mould is first of all jolted for a few seconds and the top of the mould smoothed down by squeezing it. After this the table is raised in the case of the turnover-plate type of small jolter, swung through 180 deg., and the pattern stripped from the sand from above. In the case of the lift-off type small jolter, when the sand has been rammed, the mould is lifted up by means of a hand-lever and four lift-up pins without being turned. The output with two machines, each of which is tended by one man, is about 100 to 120 moulds a day.

The coating of these castings with enamel, which is usually coloured blue, green or grey by metallic oxides, also calls for a great deal of experience. The procedure is approximately the same as for the baths, except that the ground coating is blown on in the liquid form by compressed air.

An attempt has been made in the above article to give a comprehensive description of the extremely interesting and difficult process involved in the manufacture of baths and sanitary ware. In particular, a comparison has been made between the older and more primitive methods and the highly-developed modern processes.

Lincolnshire Iron and Steel Institute.

The fourth annual dinner of the Lincolnshire Iron and Steel Institute was held on Thursday, March 13, at the Crosby Hotel, Scunthorpe, Mr. A. Crooke (President) in the chair.

Mr. H. C. Bond (Chairman of Messrs. Richard Thomas & Company, Limited), proposing the "Lincolnshire Iron and Steel Institute," pointed out how closely allied the Institute was to the iron and steel industry. The function of the Institute was to promote the prosperity of the industry of the district, by examining and discussing problems, the successful solution of which would enable steel to be made in Lincolnshire at a price and quality which would compete with the other iron and steel centres of the world. It was obvious that any district with natural advantages had a good basis, and a most important factor was to have a supply of raw material, which would enable production to be conducted on cheaper lines. In this respect, Scunthorpe and Frodingham was singularly fortunate, having many natural advantages; fuel was within reasonable haulage distance, and iron ore was on the spot. In that district the works were parts of much larger undertakings, which had huge interests in other parts of the country, and were interested in quite separate branches of the industry. He mentioned the manufacture of structural, railway, engineering and shipbuilding material, tubes, galvanised sheets, and tinplates. All who were interested in the iron and steel trade, however, had one common object in view, and that was to obtain a cheaper supply of pig-iron. That was vital to all branches, and a problem worthy of the closest investigation.

Mr. A. Crooke (President), replying, gave a brief outline of the history of the Institute since its inception. It was first formed in 1918, and made steady progress until 1921, when the great slump rendered the organisation dormant for a number of years. In 1929 they got together, and since that date had made good progress. Their financial position was very strong, and they were considering at the present time publishing their Proceedings.

Mr. George Hatton, C.B.E., proposing "The Iron and Steel Industry," said that the industry was confronted with the most serious combination of adverse circumstances in its history. It was faced with the prejudicial effects of recent and threatened legislation, probably involving increased taxation, dearer coal, and higher railway rates. It was faced also with the increased competition of other iron and steel producing countries, where outputs were increasing rapidly. The steel output of Great Britain had increased over 1913 by only 25 per cent., while the whole world production had increased some 60 per cent., due to the fact that they were admitting into this country Continental steel, equal to nearly four million tons per annum, due to bounties on exports, lower freight costs, and enormously lower wages costs than our own. The standard of living, too, in this country was higher than in any European country. The imports into this country in January reached 310,000 tons; this tonnage added to our own production for that month, to measure the demand of this country as a whole, showed that this was upwards of one million tons, which would have sufficed to occupy our industry at least 95 per cent. of its present capacity. Unfortunately, the industry had many ignorant and mischievous critics, who took every opportunity to tell the world that the British works were obsolete and inefficient, due to want of enterprise and ability. Such statements were widely believed by many both in this country and abroad. Where modernisation and reconstruction of plant had not progressed as rapidly as on the Continent and in the United States, it was not due to any ignorance of the necessity, nor the inability to carry it out, but to the stringency of finance, due to the constant drain on the resources of the industry, and the want of encouragement and assistance by the legislators in the past, and the general feeling of insecurity. Notwithstanding the discouragements and depressing restraints on capitalistic enterprise, it was directly contrary to the truth to say that British works generally were obsolete and inefficient, in face of the fine modern plants that had been established in the last few years.

Continuing, the speaker said that this country still possessed in the iron and steel industry as high a standard of administrative ability and technical talent as any in the world. He ventured to believe that the country was probably only on the threshold of what would prove to be one of the most remarkable developments in the iron and steel industry of the country. All they needed, in common with the iron and steel industry as a whole, was such economic security as would enable them to go forward with their developments, which involved the introduction of more capital—a difficult thing to find unless there was some security, then they would have an outlet for their productions, and thereby the capacity to earn profits in their industry.

Mr. W. J. Brooks proposed the toast of "Our Guests," and Mr. G. C. Lloyd, Secretary of the Iron and Steel Institute, replied.

Chrome Ore in South Africa.—According to papers received by last mail, concurrently with the progress of the Umvukwes railway, a project which, it will be remembered, primarily owes its being to the demands of the chrome fields, measures are proceeding for the opening up of other chrome deposits in various parts of Mashonaland, notably in the Hartley and North-Eastern districts, and here and there transport difficulties have gradually been overcome. Thus, e.g., the financial group which has exercised its option over the Rutala Hills chrome claims intends building a light railway out to the mines from the main line in the vicinity of Hartley. It is further reported that the value of the chrome is exceptionally high, and it is confidently expected that the enterprise will soon be functioning on a very paying scale.

XUM

Welding Cast Iron.

Discussion.

Corrosion of Welds.

The Branch-President (Mr. J. W. Gardom), commenting on Mr. Steel's reference to the importance of properly preparing a casting for welding, asked how he removed all the rust, because when a casting became cracked it was probably left outside the buildings for a time, so that a good deal of preparation would be necessary in order to remove the rust properly—if that were necessary. Again, he asked whether it was necessary to cut a "V" in the metal in order to produce a good weld, and whether better results were obtained by using dissolved acetylene or the acetylene which one produced in a generator? As to corrosion, he asked whether welding inhibited it, or whether the metal around a crack, which had been repaired by welding, was more liable to corrode as the result of the welding than it would have been originally? The Branch-President was also concerned with regard to the prices of acetylene and electric welding, and he asked whether Mr. Steel would recommend electric or oxy-acetylene welding for steel castings? He had in mind, particularly, the statement that many structures were being built up of welded steel-work to replace castings. Finally, he referred to an illustration Mr. Steel had shown of the repair of a broken weighbridge frame by means of the oxy-acetylene welding process carried out over a preheating fire, and asked whether, as the result of the welding, there was much variation in the length of the frame? He asked the question because the frame contained bolt holes, and he was wondering whether the welded casting was of exactly the same length as it was originally or whether it had been necessary to fill up the bolt holes and redrill them.

Welding Black-Heart Malleable.

Mr. C. H. Kain asked if Mr. Steel had had experience of the welding of malleable iron, particularly black-heart malleable, because the trouble with the welding of black-heart malleable was that the metal around the weld re-absorbed carbon, so that there was a high-combined carbon content in the casting and a hard ring around the weld. He understood that the welding of black-heart malleable was practised fairly widely in America by means of both the electric and the oxy-acetylene processes, and that the Americans used rods of the approximate composition of the metal of the castings they were welding and afterwards re-annealed. That method had disadvantages, because the re-annealing occupied about a fortnight, and, further, if there were any machined surfaces, they were ruined by the annealing process. He also asked if Mr. Steel had any experience of the cutting of stainless steels containing upwards of 10 or 12 per cent. of chromium. There was no difficulty in cutting nickel steels, but it was his experience that it was almost impossible to cut steels having appreciable chromium contents by means of the oxy-acetylene flame, and one had to cut such steels by means of a carbon arc or an arc of some description. The result of that, of course, was to make the cut anything up to 1 in. wide, which not only ruined the article but wasted a lot of valuable metal.

Electric Welding and Brazing.

Mr. C. S. Milne, commenting upon the inference made by Mr. Steel that one could weld cast iron electrically without preheating, and in that way obtain a weld free from cracks, said he believed that if Mr. Steel would examine a weld that had been made on cold cast iron by the electric-arc process he would find cracks present, although they were very small. For that reason, although perhaps a blowhole might be filled up here and there to make the thing less unsightly, very little would be added to the strength of the casting by electrically welding without heating. Another difficulty about electric welding was that the metal that was put on was steel and not cast iron, and, owing to the difference between the two metals, one did not produce an autogenous weld.

As to Mr. Steel's statement that cast-iron brazing was a new process, he said that certainly it had been practised a great deal more during the last three or four years than it had been previously, because some really good brazing metals had become available, but as far back as 1911 the Cast Iron Brazing Company, of London, had carried out a considerable amount of repair work by brazing, much of which, he believed, was very effective. On the whole, however, he did not think they had made such good jobs in that way as were produced by autogenous welding by the oxy-acetylene process, probably because in those early days there was no particularly-known specification for brass which would weld properly to the cast iron.

Burning-on Foreign Castings.

He did not agree with Mr. Steel's suggestion that burning-on was not appreciated by welders; a good many welders appreciated that castings could be burned-on satisfactorily, and in some cases had gone so far as to advise people that a casting could be burned-on better than welded. In his view, the blame for the slow progress made in the application of burning-on must be laid at the door of the ironfounder, who, apparently, looked upon this process as a necessary nuisance and did not want castings sent to his foundry from outside to be mended. He believed that if the ironfounders would take a little more interest in it than they had done they would sometimes secure some very lucrative jobs, because for a small repair by burning-on they could often get quite as good a price as could be obtained for a new casting, if the pattern was obtainable. Often it was too costly to produce a new casting because there was no pattern available—possibly the original casting was of foreign origin—and the making of the pattern would be expensive. In such cases the welding or burning-on process was very useful. It was for that reason that the badly-fractured motor cylinders, which Mr. Steel had illustrated, had been repaired by welding. There were no patterns of the cylinders available, and the alternatives were either to scrap a whole motor lorry or to repair the cylinders by welding. The founder, of course, was interested in making new castings, so that, perhaps, from his point of view the welding process was not so valuable. Frequently, if the pattern were available, it would be just as cheap to produce a new casting as to repair a damaged casting by welding, but, at the same time, very many castings could be saved in the foundry by welding, and foundrymen would do well to consider the merits of cast-iron welding from that point of view. A practice resorted to frequently in America, he believed, when castings were difficult to make in one piece, was to make them in sections and to weld the sections together afterwards. That was a possible future development of the welding process in foundry work here.

Competition with Castings.

Mr. V. C. Faulkner said it was by no means easy to burn-on English iron to broken American machine-tool parts—which rather negatived Mr. Milne's suggestion—and he asked why that was so. He also asked if Mr. Steel could give a list of jobs which were being built up by welding, thus replacing castings. So far he had heard only of the building-up of cases for electric motors, and to some extent switch-boxes and distribution-boxes. It appeared to him that with welding, as with casting, one had to do each job separately, and with modern systems of foundry working one could make the things in series and on a machine-shop basis equally as well as one could when welding was adopted. Welding was an individual job, just as casting was, and he did not view its ultimate competition with alarm.

Steel Industry to Benefit.

Mr. Arthur Stephenson did not agree with the view that the welder was taking work away from the foundry; indeed, the position was rather the reverse, and the welder was saving the foundry situation. A great deal of progress had been made recently on the Continent, and particularly also in the United States of America, in the direction of substituting rolled-steel sections in the manufacture of parts previously made from castings, but so long as the founders had the welders behind them to help them to make good defective castings, or to weld the components of complicated structures together, instead of having to cast those structures as complete units, they were being helped a great deal to hold their end up against the rolled-steel section business. For the welding of cast iron, the electric process had not yet advanced sufficiently far to be able to offer foundrymen a reasonable proposition. The oxy-acetylene process, on the other hand, which for a quarter of a century had fought against all sorts of difficulties, including the attitude which Mr. Faulkner had just put forward, had advanced so far that a representative of the foundry trade, in the person of Mr. Steel, was moved to tell foundrymen that they must really take notice of it. Bronze welding was a very useful adjunct to the foundry trade, and American publications indicated that a considerable amount of cast-iron welding was being done by bronze-filling in that country. By that means they were able to weld together pipes which previously were spigoted at the joints. The spigoting often made the job too expensive from the cast-iron point of view, and therefore other forms of piping had to be used, but the difficulty had been overcome by brazing cast-iron pipes together.

Mr. Stephenson mentioned that he was rather surprised that the lecturer had omitted any reference to the use of Monel metal for the welding of cast iron. This material had been used with a fair degree of success, especially for the electric arc processes, which were not at all suitable for making a proper homogeneous cast-iron weld.

The one difficulty with the use of Monel metal was that of colour. When it was used for filling up blowholes, etc., it looked very similar to the cast iron when this was fresh and clean, but immediately the cast iron began to rust, the Monel metal which was deposited in the casting showed up as bright spots, and it was very easy to detect that the casting had been repaired. Monel metal was, however, very largely used as a filling rod for the repair of locomotive cylinder castings and the like, where the material was fairly hard.

Electric Welding Favoured in Scotland.

Mr. Jas. M. Primrose (Falkirk), who conveyed the greetings of the Scottish Branch of the I.B.F. to the London Branch, said he did not consider that welding was of very great interest to ironfounders, because they had available the burning-on process, which was certainly very much cheaper than welding; they could burn-on a casting just as effectively as, if not better than, they could weld it, unless the casting was so heavy that they could not get at it. The ironfounders in the North knew very well that for light castings, weighing anything from 2 cwts. downwards, oxy-acetylene welding was not of much use, and that electric welding was the only welding process they could use safely. A great deal of work had been taken away from the foundry trade, however, by the welding process, and he had been impressed, when visiting the British Industries Fair at Birmingham, to find how many things which previously were made in cast iron are now being made of other materials welded together.

Cutting Aluminium by Oxy-Acetelene.

MR. G. C. PIERCE said he supposed most foundrymen would agree that they hated burning-on, primarily, he supposed, because the fact that it was resorted to indicated something in the nature of a failure. Discussing the relative merits of the burning-on and the welding processes, he disagreed with the views of Mr. Primrose, for it was easily possible, at any rate in a particular class of work, to make a number of welds in the time occupied in doing one burn. It was much more advantageous to weld light castings than to burn-on, from the point of view of economy and from other points of view. He asked if Mr. Steel was able to state the analyses of the iron and the bronze welding rods which he had mentioned in the Paper, or, failing that, to indicate by other means what those rods were? Finally, he asked if Mr. Steel would agree with him that it was just as difficult to cut aluminium or aluminium alloys as it was to cut a cast-iron flywheel, such as had been illustrated, and why that was so?

A SPEAKER asked whether it was possible to get a cast-iron filling rod free, or practically free, of manganese, without it being specially cast?

Foundry Welding Departments.

MR. ARTHUR STEPHENSON said he knew, from his own experience in Germany, and from information he had received from the United States, that some of the foundries in those two countries had welding shops definitely attached to them. Rejects from the foundry automatically drifted to the welding shop, and it was left to the welder to decide whether or not they could be made into useful products. The fact that welding had become so closely allied to the foundry business in those countries must have an influence, from the competitive point of view, on English practice.

Welding Failures.

DR. M. L. BECKER (National Physical Laboratory) said his experience of welded steel was that, as a rule, the welds lacked reliability. If a foundryman produced a casting which was not satisfactory, the machine shop would not take it, and the onus of producing a new casting was on the foundry. On the other hand, the welder, when asked to put matters right, would often accept the task with the remark that he would do what he could with it, but that it was not his responsibility if it did not come out very well. Dr. Becker said he did not know whether that was altogether fair or true generally, but it was his experience, at any rate. He confessed that he would have been a little more satisfied with the Paper if Mr. Steel had given a few examples of failures, because he must have experienced some, and there was much to be learned by the examination of failures. He (Dr. Becker) had to examine very many failures and try to discover their causes. With regard to cracks, he had understood Mr. Steel to say that the use of a steel filling rod led to the production of hard metal in the joint. He did not see why that should be so, and would like some explanation of it. Presumably the steel was free from silicon, but he had understood Mr. Steel to say that even with a fair amount of silicon in the steel one could not get a soft joint. Though he was ready to accept Mr. Steel's word that the rods must not contain manganese, it seemed remarkable that that should be so, because manganese in cast iron, in the presence of silicon, did not appear to lessen the tendency to graphitise, and he was rather inclined to think that if manganese were present with silicon in the welding material it should not prevent the material being fairly soft.

Impact Testing of Welds.

With regard to the stresses set up in castings on cooling, he said he had seen examples of castings which, although they had been satisfactory when welded, had cracked when they were practically cold, and had wondered whether heat-treatment at a temperature of, say, about 400 deg. C. would have prevented that cracking. The heat-treatment, of course, would have to be carried out immediately after the welding was completed.

The tensile test was one of which welders seemed to be very fond. Mr. Steel had referred to examples of steel castings having a tensile strength at the weld equal to 120 per cent. of the tensile strength of the material before welding. One could quite understand that in cases where the material had been hard, but he asked Mr. Steel if he could give examples of the results of impact tests on the material filled into the welds. He himself had had occasion some time ago to make quite a number of tests of oxy-acetylene welded steel, and in that case the tensile tests had shown that the welds were quite good, the elongation being quite appreciable, because most of the elongation had occurred in a portion of the material outside that which had been actually welded. On the other hand, small impact-test specimens, cut out of the welds themselves, had given very low values indeed, and for that reason, in this particular case—it was a case of welding steel drums—that method of welding was absolutely ruled out. There was, in this instance, the alternative of using water-gas heated, forge-lap welds, which seemed to be infinitely superior.

MR. A. B. HARROWER was particularly interested in the bronze welding of a motor-cylinder water jacket, and asked why it was difficult to apply the bronze-welding method in that particular case? Every winter there were thousands of cracked water jackets needing repair, and if only they could be welded satisfactorily by some system which would not involve distortion, he was perfectly certain that the garage welder would find a very considerable addition to his business.

The Burning-on Process.

MR. M. J. COOPER asked how far welding was acceptable to Lloyd's and similar bodies? Some of the castings Mr. Steel had illustrated could be dealt with very simply by burning-on, but some of them were such that the burning-on of them was an impossible proposition. In the burning-on that he had done he had always adopted the practice of burning-on from the top and taking the metal away from the bottom, to localise the heat. That method was far more successful than others, in his experience.

In undertaking any burning-on job, he had endeavoured, whenever possible, to take the running metal away from the underside of the fracture, and first of all made perforations all along the fracture—either by drilling holes as large as possible—or by saw cuts, and if not restricted by final dimensions, to keep the fracture open a little—and by so doing to allow the metal to flow freely and rapidly through the fracture. After allowing sufficient metal to flow through the fracture and away by the conduit, he stopped up the conduit with a clay "bott" and then filled up the burnt portion level with the top surface and allowed surplus metal to trickle off from the overflow. This method would be found of very general application, the cold metal of the fracture melted very rapidly and the radiated heat was very limited.

Sometimes, to overcome local and general strains, it became admissible to break a casting in another part, and made two burns to turn out a satisfactory repair. A little aluminium added to the burning metal was an advantage.

Brittle Castings Eliminated.

MR. F. HODDLE agreed that there were many jobs for which the burning-on process was much more economical than the acetylene-welding process, but, on the other hand, there were many jobs which could be done by means of acetylene welding but which could not be done by burning-on. For example, one could take a welding plant into a factory, if a breakdown occurred, and carry out repairs, but one could not take the burning-on plant there; a burning-on job must be brought to the foundry. If it were possible to replace a casting as quickly as one could repair a broken casting, then one would not hear so much about welding, but it was clear that welding had come to stay. There were many articles being made by means of welding for which castings were used previously, and in this connection he instanced the exhaust manifold, of which probably more were being made to-day by oxy-acetylene welding than by casting. If a man hit a welded manifold with a spanner it would not break, but would merely bend, and that was a great advantage of the use of sheet metal for motor parts.

AUTHOR'S REPLY.

Pure Gas Desirable.

MR. STEEL replied to the discussion. Dealing with the problem as to whether one should use dissolved or generated acetylene, he said he contended generally that if one used dissolved acetylene there was not the possibility of impurities being imparted to the weld, because of the greater purity of the gas, but there was no reason why one should not produce a good weld with a generated acetylene. He exhibited an example of a weld made with generated acetylene; it was quite a good weld, and was soft, machinable, and absolutely homogeneous. Discussing the Branch-President's question as to whether it was cheaper and better to use the electric or the acetylene process for welding steel castings, he said the steelfounder had the advantage of the ironfounder, in that he was working with a metal with which he could take far more liberties. A cast-iron casting might have a tensile strength of only 10 tons, and very little elasticity, but, on the other hand, one might have a steel casting with a tensile strength of anything from 28 to 40 tons per sq. in., and an elongation of perhaps 26 per cent. There was very little danger of expansion or contraction cracks developing, and one was not obliged to pre-heat such material for welding. Invariably the electric arc process was chosen for welding steel castings, partly because of its convenience, and also because it was undoubtedly cheaper than the oxy-acetylene method for the welding of steel castings. The welding heat was generated almost instantaneously with the electric arc process, whereas with the oxy-acetylene process it would probably take five minutes to work up welding heat, and the possibility of distortion was increased because the heat spread to the surrounding areas. With the electric arc method the job could be done very efficiently and quickly, and one was using a rod more or less of the same composition as that of the casting on which one was working.

Official Attitude Towards Welds.

Replying to Mr. Cooper's question as to the attitude of the great inspecting authorities towards welding, he said he did not think they entertained it for a single moment so far as cast iron was concerned, but they did make an allowance on steel castings. Certain regulations had been drawn up by these authorities, and they often permitted welding to be carried out, with their knowledge, on a steel casting, if those regulations were complied with. If the founders who made the casting found that it had a defect, and if they were honest, they brought it to the attention of the inspector, who would either give permission to weld, on his own authority, or would obtain a sketch of the casting, indicate the defect on that sketch, and send it to headquarters, in which case headquarters would either condemn the casting or give permission to weld it. If permission were given to weld it, it was re-examined and stamped after welding, and it was watched carefully throughout the machining process.

Colour Difficulties.

There was a fortune awaiting the man who could produce a material for welding steel cast-

XUM

ings which would not show up in a different colour from that of the castings during machining. So far, when a casting came to the lathe or planing table, one could always detect whether or not it had been welded. The weld might be perfectly homogeneous, but one could see a distinct line of demarcation even after annealing. He had seen approximation in colouring once, in a piece of wrought-iron plate, and he believed the reason for the approximation was that the welding material had a composition which was practically identical with that of the plate itself. That was not practicable, however, in the welding of steel castings, because those castings, like cast-iron castings, were so often made to particular specifications, so that they varied, and one could not always have rods made specially to particular analyses, because it was not a commercial proposition to do so.

Distortion.

With regard to distortion, the welder must do his very best to prevent it, and was always at great pains to ensure that castings were returned to the users in such condition that they could be put back into use with the least possible trouble. In this connection he mentioned a large ring, 5 or 6 ft. in diameter, which constituted part of a bottle-making machine, and which was repaired by welding so well that when it was re-fitted to the machine it was found that the holes were only 0.01 in. out.

As to the welding of malleable castings, he exhibited one which had been bronze-welded—and that was, in his opinion, the only feasible method of welding malleable iron whilst at the same time retaining its malleable properties. Whenever a malleable casting was heated above its critical point it was re-carburised, so that in that way one was undoing the good work that had been done in the annealing process. The only true method was to weld it and then subject it to the annealing process. That was not practicable, however, in the case of machined parts, because the machined faces would be spoiled; one could not prevent a certain amount of scaling, and possibly distortion would occur. The temperature at which one could carry out the bronze-welding of a malleable part was sufficiently low to safeguard its malleable properties. Probably the melting point of the iron was in the region of 1,200 deg. C., and one could weld at about 700 or 800 deg. C.

High Chrome.

He had no knowledge of the cutting of steel containing 12 per cent. of chromium, and did not know whether the difficulties experienced were due to the very high melting point of the chromium.

Mr. Faulkner said they were due to chromium oxide.

Mr. Steel said that the difficulties of cutting aluminium were due also to the very high melting point of the aluminium oxide.

Replying to Mr. Milne's criticism as to the cracking of castings welded by the electric process, he said there appeared to be some misapprehension; he had not stated in the Paper that with the electric process there was a guarantee against cracks—indeed, the opposite was the case.

Dealing with Mr. Faulkner's question as to why American cast iron was not easily welded or burned, he said he had heard the question raised a long time ago, and in his recollection the explanation given was the difference in composition, but what the difference was exactly he could not say. That might be one reason why the bronze method of welding cast iron was so popular in America. As to the making of parts from soft steel by welding, he said that electric motor bodies and stators were being made in this way, as also were machinery bases, and he suggested that, if the ironfounder was losing as the result of the greater application of welding, he did not see why the steelworks should not gain, because if they were to apply themselves to a study of welding potentialities they could make a far greater variety of shapes, rolled and drawn, to meet the demands for welded structures. The difficulty with the fabrication of machinery was that one could not get the rounded contours that could be obtained in a cast job, but he had seen fabrications of machinery bases which possessed the rounded contours and symmetry of line that would have been possible if they were cast. They were of channelled "U" section. He did not know whether special plant was used, but imagined that there would be a big field for the steelmakers if they could roll that section in different depths and sizes. The fabricated bases looked very nice, and weighed only from half to two-thirds as much as cast-iron castings.

As to the welding of cast-iron piping, he did not know whether it was being done in this country, but in America, where oil, water and other commodities were conveyed over great distances by means of pipe lines, the problem of keeping the joints tight had been overcome by welding. When using cast-iron pipes they joined two or three sections, of 12 ft. or so, in the factory, using the bronze process. There were two or three types of joint; in some cases it was spigoted and had a collar welded round it; in others it was "Veed."

Although he had not mentioned the point in the Paper, it was quite obvious that Monel metal could be used for welding, because it was a copper alloy, and that was more or less true of all copper alloys. Provided they were sufficiently pure, they could be used, to some extent at any rate, for welding. They did not give autogenous welds, but by their use one could accomplish repairs at heats very far below actual welding heat.

The suggestion made by Mr. Primrose that for the welding of light castings the acetylene process had been discarded in favour of the electric, was contrary to his own experience.

He was unable to give the analyses of the super-silicon and bronze rods, because they were not his to give, but it was quite evident, from the name, that in the super-silicon rod the essential constituent was silicon, and that the rod contained an extra amount of that constituent. If the casting contained 2.2 per cent. of silicon, the rod used would normally contain from 3½ to 4 per cent. There were two kinds of rods—the ferro-silicon and the super-silicon—but the former were not quite so good as the latter; the latter contained more silicon and was made from a better brand of iron. The ideal rod for bronze welding was more or less a straight brass, as free as possible from impurities. Perhaps he had been rather rash in stating that welding rods must be free from manganese; that was the ideal to be aimed at, but one must safeguard against the effects of manganese by keeping the manganese content as low as possible, by choosing, for the making of the rods, a pig-iron low in manganese and high in silicon.

It was true, as Dr. Becker had stated, that there had been failures, and we should not have known so much about welding as we do if there had not been. The reason why steel produced a hard weld on iron was that the steel deposit was carburised by absorbing carbon from the iron.

Dealing with Mr. Harrower's request for information concerning the bronze welding of motor-cylinder jackets, he said that the bronze method was often boosted, particularly in the American welding papers, as an ideal method for repairing them, but sometimes it was successful and sometimes it was not; it all depended upon the location of the defect. It must be remembered that the welding of a cylinder jacket was equivalent to welding a piece of flat plate in many cases, because the outer wall was not supported in any way with brackets or anything of that nature. When the blowpipe was applied to it, it would not expand, neither would it distort, so that it would crack further. The best suggestion he could make as to the repairing of a cracked cylinder jacket was to drill a small hole at each end of the crack, in order to prevent the crack extending, then to preheat to black heat and proceed with the bronze welding. The crack must be "Veed" out first, of course, unless one was prepared to accept an ugly-looking deposit, simply laid on the surface. As to the cleaning of the castings before welding, one usually cut them out; sometimes they were sand-blasted, and if they were difficult to get at they could be pickled, but they must be washed with soda after pickling in order to ensure that no acid was left on them. The bronze method was not infallible, and the welder must use his discretion. The location of the defect must be studied, as well as the section on which the work had to be done.

Discussing the attitude sometimes adopted towards the problem of welding a new casting, he said he could not comprehend the mentality of a man who, as a private individual, was prepared to take advantage of welding in some part of his motor car or some of his domestic appliances, and was satisfied with the job, in so far as he probably trusted his life to it afterwards, but yet, in another capacity, would not entertain the idea of welding a new casting. Finally, Mr. Steel expressed thanks to Mr. C. S. Milne for having lent him the illustrations shown of various applications of welding, and to the British Oxygen Company for having allowed one of their operators to give a practical demonstration of welding.

Electrolytic Corrosion.

The Branch-President said it seemed to him that the majority of castings which were repaired by welding seemed to have been broken as the result of the solidification of water, the consequent expansion having cracked the castings. That was the reason he had mentioned the problem of corrosion, but Mr. Steel seemed to have treated it as of little importance. Whether or not one agreed with Prof. Desch, or with the theory of electrolytic corrosion, it seemed to be true that when there were two dissimilar metals together in the presence of moisture they would corrode more rapidly than a single metal, and whenever he was asked whether welding was better than casting, he would draw attention to that.

Mr. Steel replied that undoubtedly excessive corrosion would occur where there was not proper penetration, because a portion of the crack or defect would be left open to the ravages of corrosion, but where one secured perfect penetration, and welded the section through and through, he did not think it was any more liable to corrosion than was the original section. A new theory of corrosion had been propounded recently and it had to do with the ionisation of metals. He did not think it was yet sufficiently developed to enable one to say anything definite with regard to it, but it opened up a new field of investigation, and so far as the corrosion and erosion of metals was concerned we had still a lot to learn. In aluminium welding one must be very careful to ensure that there was no oxide included in the weld, and that all the flux was washed away. That was not so important in cast-iron welding, but one must use the purest materials possible to ensure a good, sound, homogeneous joint, and when one had taken those precautions one had done as much as one could to prevent corrosion.

On the motion of Mr. A. W. G. Bagshawe, seconded by Mr. Corbyn, a hearty vote of thanks was accorded Mr. Steel for his Paper.

Scleroscope Hardness of Chilled Rolls.—In an article in a recent issue of "Blast Furnace and Steel Plant," describing the scleroscope hardness of chilled rolls, it is pointed out that the measure of surface hardness gives an erroneous impression of the true value of the roll when put into service.

The Iron and Steel Industry Since the War.*

A REVIEW OF THE INDUSTRY IN GREAT BRITAIN AND FOREIGN COUNTRIES.

By M. S. Birkett, O.B.E.†

It is ten years almost to a day since the author submitted a Paper dealing with the iron and steel industry during the war, and a period of ten years is a very convenient one to summarise, although during the whole of that interval there has scarcely been a period that could be described as normal. This Paper is an attempt to give a straightforward account, in as brief a space as possible, of the chief developments of the iron and steel industries in the main producing countries since the war. In view of the important developments which have taken place in other producing countries, it is obvious that the position in Great Britain cannot be understood without a survey of the world position, and while the longest section naturally deals with the position in this country, the other producing countries are dealt with at various lengths.

WORLD POSITION.

In 1913 the world production of pig-iron reached 78,000,000 tons, which was the highest figure ever recorded and practically double the production of 1900; during the war years the nearest approach to this figure was the 73,000,000 tons recorded in 1916; in the post-war period it was not until the year 1926 that the pre-war rate of output was again attained; each year since 1926 has shown an advance on the previous year, and in 1929 the highest output in history was reached, when the total world production amounted to practically 96,000,000 tons. Tables I and II give the world output of pig-iron and steel from 1900 to 1929.

TABLE I.—*World Production of Pig-Iron.* (*Millions of Tons.*)

Year.	Total.	U.K.	Belgium.	France.	Germany.	Luxemburg.	Saar.	U.S.A.	Other Countries.
1900	39·81	8·96	1·00	2·67	7·43	0·96		13·79	5·00
1	39·81	7·93	0·75	2·35	6·85	0·90		15·88	5·15
2	43·36	8·68	1·05	2·37	7·23	1·06		17·82	5·05
3	45·73	8·94	1·20	2·79	8·66	1·20		18·01	4·93
4	44·71	8·69	1·27	2·93	8·72	1·18		16·80	5·42
5	53·24	9·61	1·29	3·02	9·35	1·35		22·99	5·63
6	58·03	10·18	1·35	3·26	10·66	1·44		25·31	5·83
7	59·68	10·11	1·34	3·53	11·21	1·46		25·78	6·21
8	47·58	9·06	1·28	3·35	10·34	1·28		15·94	6·37
9	59·47	9·83	1·69	3·62	10·91	1·53		25·80	6·59
1910	64·76	10·01	1·82	3·97	12·89	1·66		27·30	7·11
1	62·76	9·53	2·01	4·40	13·63	1·70		23·65	7·84
2	72·37	9·75	2·26	4·86	15·35	2·22		29·73	9·20
3	77·90	10·23	2·45	5·12	16·49	2·51		30·97	10·10
4	59·38	8·92	1·43	3·65	12·29	1·80		23·33	8·03
5	69·70	8·79	0·67	0·88	10·03	1·67		29·92	8·74
6	72·82	9·05	0·13	1·47	11·15	1·92		39·44	9·66
7	69·76	9·32	0·01	1·71	11·42	1·81		38·62	7·17
8	64·95	9·09	—	1·29	10·51	1·25		39·06	3·75
9	51·89	7·40	0·25	2·37	6·19	0·61		31·02	4·05
1920	62·85	8·03	1·10	3·38	6·93	0·68	0·88	36·93	4·92
1	37·68	2·62	0·86	3·31	7·72	0·95	1·13	16·69	4·40
2	54·78	4·90	1·59	5·14	9·25	1·65	1·14	27·22	3·89
3	68·71	7·44	2·11	5·34	4·85	1·38	1·00	40·36	6·22
4	67·13	7·31	2·80	7·57	7·68	2·12	1·37	31·41	6·87
5	75·69	6·26	2·50	8·36	10·01	2·33	1·43	36·70	8·10
6	77·52	2·46	3·35	9·28	9·50	2·52	1·61	39·37	9·43
7	85·40	7·29	3·69	9·18	12·90	2·69	1·74	36·57	11·34
8	86·94	6·61	3·84	9·82	11·62	2·73	1·91	38·16	12·25
9	90·60	7·58	4·00	10·30	13·19	2·83	2·10	42·29	13·61

TABLE II.—*World Production of Steel.* (*Millions of Tons.*)

Year.	Total.	U.K.	Belgium.	France.	Germany.	Luxemburg.	Saar.	U.S.A.	Other Countries.
1900	27·83	4·90	0·63	1·54	6·36	0·18		10·19	4·03
1	30·56	4·90	0·51	1·40	6·04	0·25		13·47	3·99
2	33·96	4·91	0·76	1·54	7·34	0·31		14·95	4·15
3	35·51	5·03	0·95	1·81	8·29	0·37		14·53	4·53
4	35·74	5·03	1·05	2·06	8·43	0·36		13·86	4·95
5	44·22	5·81	1·18	2·22	9·51	0·39		20·02	5·09
6	50·40	6·46	1·37	2·41	10·53	0·43		23·40	5·80
7	52·13	6·52	1·44	2·72	11·43	0·44		23·36	6·22
8	40·75	5·30	1·18	2·68	10·56	0·45		14·02	6·56
9	53·38	5·88	1·55	2·99	11·32	0·53		23·96	7·15
1910	59·33	6·37	1·91	3·36	12·89	0·59		26·09	8·12
1	59·57	6·46	2·15	3·78	14·08	0·70		23·68	8·72
2	71·62	6·80	2·47	4·36	16·09	0·93		31·25	9·72
3	75·15	7·66	2·43	4·61	17·32	1·31		31·30	10·52
4	59·49	7·84	1·37	2·61	13·59	1·12		23·51	9·45
5	65·57	8·55	0·10	1·07	12·09	0·97		32·15	10·64
6	77·01	8·99	0·10	1·92	14·64	1·29		42·77	7·30
7	80·76	9·72	0·01	2·20	15·26	1·07		45·06	7·44
8	75·99	9·54	0·01	1·78	13·87	0·87		44·46	5·46
9	87·56	7·89	0·33	2·15	7·72	0·36		34·67	4·44
1920	71·30	9·07	1·23	3·00	8·40	0·67	0·73	42·13	6·17
1	43·51	3·70	0·78	3·05	8·93	0·74	0·91	19·78	5·62
2	67·66	5·88	1·54	4·46	11·53	1·37	1·24	35·60	6·04
3	76·93	8·48	2·26	5·03	6·20	1·18	0·98	44·94	7·86
4	77·23	8·20	2·83	6·79	9·68	1·86	1·45	37·93	8·49
5	88·53	7·39	2·51	7·33	12·00	2·05	1·55	45·39	10·71
6	91·75	3·40	3·32	8·30	12·15	2·21	1·71	48·29	12·17
7	100·17	9·10	3·66	8·18	16·06	2·43	1·86	44·94	13·94
8	107·98	8·52	3·87	9·35	14·29	2·53	2·04	51·54	15·84
9	117·88	9·65	4·05	9·52	15·99	2·66	2·19	56·60	17·82

The proportions in which the various countries contributed to the total in 1913 and 1929 are shown in Table III, where it will be seen that Great Britain's share fell from 13.2 per cent. of the total in 1913 to 7.9 per cent. in 1929; that the United States' proportion increased from 40 per cent. to 44 per cent.; that of Belgium and the Saar increased substantially, while that of France, in the present territory, declined; the proportion contributed by the present territory of Germany and Luxemburg remained practically stationary, while there was a slight increase in the proportion by the lesser producing countries.

Steel production in 1913 had attained rather more than 75,000,000 tons, which was nearly three times as much as in 1900, but this figure was exceeded in 1916, 1917 and 1918. After the war the 1913 output was again exceeded in 1923, since when each year has shown an advance varying from the 0.4 per cent. increase between 1923-24 to the 15 per cent. increase between 1924-25. While the world-production of pig-iron therefore exceeds that of 1913 by 23 per cent., steel production was in excess of the 1913 production by 57 per cent. It will be seen from Table III that in 1913 Great Britain contributed 10.2 per cent. of the world output of steel, but only 8.2 per cent. in 1929, and that the United States' proportion increased from 42.0 per cent. to 47.5 per cent. Owing to the great increase which occurred in the United States, the proportions contributed by all other countries except Belgium and Luxemburg declined. Whereas in 1913 the tonnage of pig-iron produced slightly exceeded that of steel, in 1929 steel production was 23 per cent. higher than pig-iron production. This is due to two factors, the more important of which is the increased use of scrap; the other factor is the substitution of steel in many instances where iron was formerly used.

TABLE III.—*World Production of Pig-Iron and Steel,* 1913 *and* 1929. *Proportions of Chief Producing Countries.*

	Pig iron.		Steel ingots and castings.	
	1913.	1929.	1913.	1929.
	Per cent.	Per cent.	Per cent.	Per cent.
Great Britain	13.2	7.9	10.2	8.2
Belgium	3.2	4.2	3.2	3.4
France (post-war territory)	11.4	10.8	9.1	8.1
Germany (post-war territory)	13.7	13.8	16.0	13.6
Luxemburg	3.2	3.0	1.7	2.3
Saar	1.7	2.2	2.7	1.9
United States	40.0	44.0	42.0	47.5
Other countries	13.6	14.1	15.1	15.0
World	100.0	100.0	100.0	100.0

As already stated, it was not until 1926 that the output of pig-iron again reached the 1913 level, for in spite of the demand which might have been expected to accumulate owing to the destruction of property caused by the war and the concentration of production for so many years on war material, the world was too impoverished by the war to make this demand effective. The belligerent countries, who before the war had supplied capital for development, were no longer in a position to do so on the same scale, and much development work had to be postponed. A table in the Paper, illustrating this, shows that exports from iron and steel producing countries to the rest of the world did not reach 1913 proportions until 1927, since when they have steadily progressed.

GREAT BRITAIN.

Production.

We have seen that the world production of pig-iron did not again reach the 1913 level until 1926; in the case of the United Kingdom the 1913 output has not again been attained. In the boom year of 1920 an output slightly exceeding 8,000,000 tons was reached; this was followed by the violent slump in 1921, accentuated by the three months' coal strike in that year, which caused the output of pig-iron to fall to 2,620,000 tons. From this low level it gradually rose, and under the stimulation of demand caused by the occupation of the Ruhr, with the consequent dislocation of German and French production for the greater part of 1923, an output of 7,440,000 tons was registered. Output was fairly well sustained through 1924, but fell to 6,260,000 tons in 1925, while the coal stoppage and general strike of 1926 caused practically every blast furnace in the country to cease operations for several months, so that production for the year only amounted to 2,460,000 tons. In consequence of the orders which accumulated during the coal stoppage, the demand in 1927 was considerable and the output attained 7,290,000 tons, but fell off again to 6,610,000 tons in 1928. Last year (for reasons which will be considered when dealing with steel production) output rose to 7,580,000 tons, which was the best figure since 1920.

Already, however, the number of furnaces blowing is eleven less than in August last and production is on a declining curve, so that present indications are that the 1930 output is likely to be below that of 1929. It is at first glance surprising that the output of pig-iron between 1913 and 1929 should have declined while the production of steel increased. The reasons for the reduction in pig-iron output are the increased use of scrap for steelmaking; the increased use of scrap in iron foundries; the depression in the wrought-iron industry; and the decline in export trade. During the war the abundant supplies of scrap available encouraged the development of improved tech-

TABLE IV.—*Dividends Paid on Ordinary Share Capital.*

	1911.	1912.	1913.	1923.	1924.	1925.	1926.	1927.	1928.
Armstrong, Whitworth & Co., Ltd. ...	% 12½	% 12½	% 12½	% 5	% 5	% —	% —	% —	% —
Baldwins, Ltd. ...	10	10	10	—	—	—	—	—	—
Barrow Hematite Steel Co., Ltd. ...	—	—	—	—	—	—	—	—	—
Beardmore, Wm., & Co., Ltd.	5	5	5	—	—	—	—	—	—
Blaenavon Co., Ltd.	—	—	5	—	—	—	—	—	—
Bolckow, Vaughan & Co., Ltd.	5	10	6	—	—	—	—	—	—
Brown, J., & Co., Ltd.	7½	7½	10	5	5	—	—	—	—
Cammell, Laird & Co., Ltd.	—	—	2½	—	—	—	—	—	—
Cargo Fleet Iron Co., Ltd. ...	—	—	—	—	—	—	—	—	—
Coltness Iron Co., Ltd.	10	15	8	5	10	7½	10	10	5
Consett Iron Co., Ltd.	45	60	30	7½*	2½	—	—	—	—
Dorman, Long & Co., Ltd.	6	7½	8½	—	—	—	—	—	—
Ebbw Vale Steel, Iron and Coal Co., Ltd....	3	10	10	—	—	—	—	—	—
Guest, Keen and Nettlefolds, Ltd., C.B.	10 5	10 5	10 5	10	10	10	10	10	10
Hadfields, Ltd. ...	17½	20	20	4	2½	3	2½	5	2½
Millom and Askam Co., Ltd.	7	8½	12	—	—	—	—	—	—
Palmers' Shipbuilding and Iron Co., Ltd....	—	—	—	—	—	—	—	—	—
Pease and Partners, Ltd.	8	12	12	8	1½	—	—	—	—
Scott, Walter, & Co., Ltd.	—	10	5	—	—	—	—	—	—
Scottish Iron and Steel Co., Ltd.† ...	—	—	—	6	4	5	—	8	5
Sheepbridge Iron and Coal Co., Ltd. ...	10	20	15	7½	5	5	7½	2½	2½
South Durham Steel and Iron Co., Ltd....	10	20	25	10	10	10	5	5	6
Staveley Iron and Coal Co., Ltd. ...	10	25	12½	10	7½	5	7½	5	5
Stewarts and Lloyds & Co., Ltd., P. ... D. ...	? 10	? 10	10 12½	10 12½	10 12½	10 7½	10 2½	10 5	10 5
Thomas, R., & Co., Ltd.	?	?	?	3½	5	2½	—	—	—
United Steel Cos., Ltd.	?	?	?	—	—	—	—	—	—
Vickers, Ltd.	10	10	12½	—	—	—	—	8‡	8‡

* Nine months. C.B. Cash Bonus.
† Company formed June, 1912. P. Preferred Ordinary.
‡ After reconstruction. D. Deferred Ordinary.

* From a Paper read before the Royal Statistical Society March 18, 1930.

† Secretary of the National Federation of Iron and Steel Manufacturers.

nique, whereby increased quantities of scrap could be used in steel furnaces. Whereas before the war the proportion of scrap amounted on the average to about 30 per cent. of the furnace charge, since the war that proportion has been in the neighbourhood of 50 per cent.; the increased use of scrap in 1929 was equivalent to about 2,400,000 tons of pig-iron.

Exports of pig-iron, excluding ferro-alloys, in 1913 amounted to 945,300 tons; in 1929 they amounted to 455,600 tons. A large part of the decline is in exports to Continental countries, where productive capacity has been substantially increased since the war, and where, in the case of Germany and France, the home market is protected by a duty of 10s. per ton. It is not without significance that Belgium, where the tariff on pig-iron is very small, took rather more pig-iron from this country in 1929 than in 1913. India not only now makes all the pig-iron she requires, but also exports pig-iron on a considerable scale. In fact, Indian pig-iron was imported into Great Britain at about 5,900 tons per month in the last quarter of 1929. The exports from India to Japan are largely responsible for our loss of the Japanese market, which only took 7,800 tons from Great Britain in 1929, compared with 97,000 tons in 1913. Australia also can now meet almost the whole of her requirements in pig-iron, so that exports to Australia, which in 1913 amounted to 36,100 tons, amounted only to 8,600 tons in 1929. For the same reason exports of pig-iron to Canada fell from 35,600 tons in 1913 to 6,900 tons in 1929.

In the case of steel, the 1913 level has not only been again reached but considerably exceeded. In fact, in only four years since the war (1921, 1922, 1925 and 1926) has the output been less than in 1913. The difficulty, therefore, is not that production is less than pre-war, but that it is so low in relation to the increased capacity of the industry (during the war capacity was increased by at least 50 per cent.) and in relation to the production of competing countries. The improvement in production in 1929 was due to two main causes—the high level of world demand in general, which made possible a high rate of operations in the iron and steel works on the Continent, and the improvement in the shipbuilding position.

The exceptional activity in Continental works last year (for the major portion of the year the iron and steel industry on the Continent was working near to capacity) was such as to preclude them from increasing their exports to Great Britain, so that, although the total imports of iron and steel into Great Britain in 1929 were only a little less than in 1928, they would have been much higher but for the fact that the Continent was working practically up to capacity for its home markets and for markets other than Great Britain, so that it had no margin from which to increase its exports to this country.

After analysing the imports and exports of iron and steel into and from Great Britain, the author proceeds:—

Prices.

There is no need to deal in detail with the history of iron and steel prices since the war, for the Board of Trade publishes a comprehensive index-number including about 25 typical iron and steel products. The base is the average of prices in 1913, and at the height of the 1920 boom the index touched 390.6. By the end of 1920 it had fallen to 336.9; by the end of 1921 to 152.1; and by the end of 1922 to 131.3. Prices rose during the Ruhr occupation, and in April, 1923, the index stood at 160.4, after which prices again fell consistently, and the index was 149.2 by the end of the year; 136.1 in December, 1924; and 118.3 in December, 1925. The scarcity created by the coal stoppage in 1926 again sent up prices, and in November, 1926, the iron and steel price index stood at 134.5. It then again declined steadily until in December, 1927, it was 113.6, and at the end of 1928, 112.3. Owing to the increased demand during 1929, prices for iron and steel products rose, but the index was never higher than 115.3 (October, 1929). Higher prices in 1929 for saleable products, however, were offset by increases in the prices of raw materials such as iron ore, coal and coke.

Finance.

Adequate consideration of the financial results of the companies engaged in iron and steel manufacture would require a Paper to itself. The writer, therefore, gives in Table IV a statement showing the dividend paid on the ordinary share capital of 27 iron and steel companies in 1911, 1912 and 1913, and in each year since 1923. These companies are responsible for about 70 per cent. of the pig-iron output of the country and over 60 per cent. of the steel.

The depressed condition of the industry has been brought home to the general public by the fact that many iron and steel firms have had to undergo financial reconstruction within the last few years, and that many well-known iron and steel concerns have paid no dividend on their ordinary shares for many years. The following firms, among others, have paid no dividend on their ordinary shares since 1921:—(1) Messrs. Bolckow, Vaughan & Company, Limited; (2) Cargo Fleet Iron Company, Limited; (3) Ebbw Vale Steel, Iron & Coal Company, Limited; (4) Wm. Beardmore & Company, Limited; (5) Blaenavon Company, Limited; (6) the United Steel Companies, Limited; (7) Baldwins, Limited; (8) Dorman, Long & Company, Limited; (9) Barrow Hematite Steel Company, Limited; (10) Palmers' Shipbuilding & Iron Company, Limited; (11) Millom & Askam; and (12) Hematite Iron Company, Limited.

These firms have to-day a paid-up ordinary share capital of over £28,000,000, and in addition debenture and preference capital amounting to £30,000,000, and are producing about 40 per cent. of the pig-iron and steel output of the country.

Twenty-nine works for the manufacture of pig-iron, comprising 97 furnaces, were idle at June 30, 1929, and in addition eight works with 20 furnaces have been dismantled within the last few years. These 37 works in 1920 produced 1,587,000 tons of pig-iron, or nearly 20 per cent. of the total output of pig-iron in that year. In the case of steel, works responsible for the production of 667,300 tons, or 7 per cent. of the total output of 1920, are now idle or dismantled.

Reasons for the Depression.

The depression is obviously the result not of one but of many causes; it is not primarily due to lack of demand, for although home demand would have been greater had the shipbuilding, general engineering and other consuming industries been more prosperous, the total demand for the home and exports markets together, if met from home sources, is sufficient to enable the steelworks to operate practically at full capacity. The reasons for the depression must be sought in the causes which enable the total demand to be met to an increasing extent from foreign sources.

In the first place, the result of the different financial policies pursued by Great Britain and the Continental countries has obviously been to favour Continental industries at the expense of British. One important result of the inflation policy followed by Germany, France and Belgium was to reduce to negligible proportions prior capital charges, while reparations payments and war compensation have enabled all three countries to obtain magnificently equipped works at very low capital cost. Thus the fixed capital charges as a factor in production costs are very materially reduced as compared with the heavy burden borne by the British industry. It must be admitted, however, that in the case of Germany the subsequent shortage of capital and high interest charges proved a serious handicap.

During the period of depreciating currency, Continental countries were not only enabled to make extensions at a comparatively low cost in gold, but a powerful stimulus was given to the export trade, since at such periods, as is well known, the external value of the currency depreciates much more rapidly than the internal value.

Wages in the iron and steel industry in this country are substantially higher than in any of the Continental countries. For the iron and steel industry as a whole, wages in Germany approximate to about 75 per cent. of those ruling in Great Britain, while France, Belgium and Luxemburg have wages 50 per cent. or less. These figures are based on a 48-hour week and take into account the payment of family allowances which are common in Continental countries. The lower wage levels on the Continent are made possible because of the lower standards and cost of living obtaining in the different countries as compared with Great Britain. It is not suggested that the British worker is twice as well off as the Belgian and French worker, but it is the effect of these low wages on a sterling basis with which Great Britain has to compete.

One great asset of the British iron and steel industry is that her works are geographically well situated in relation to their coal and ore supplies and for importing raw materials and exporting finished products. This advantage has, however, been greatly minimised by the high level of railway rates, which, in the iron and steel industry, are on the average 65 per cent. above pre-war. The seriousness of this handicap will be recognised when it is recalled that iron and steel prices are only 15 per cent. above pre-war, and that transport charges amount to one-fourth, and in certain cases to more than one-third of the cost of pig-iron.

(To be continued.)

The Continental Steel Cartel.

The most important matter before the meeting in Paris recently of the representatives of the national groups in the Continental Steel Cartel was the decision to prolong the agreement provisionally until the end of September. At the same time the productive programme of the national groups in the second quarter was fixed on the same basis as in the first quarter. Selling conditions for the present remain without change.

According to the brief reports of the deliberations of the conference, it has been found impossible to come to an understanding with the representatives of the Austrian, Hungarian and Czech works (the so-called Central European group) as regards their rejoining the Cartel. However, it is said that a "gentlemen's agreement" was entered into in the matter of prices under which the Central European works have undertaken to observe the selling prices of the Cartel for their total exports, including the Balkans.

A further meeting of the group representatives is to be held about the end of March, and it is reported, although this lacks confirmation, that the managing committee of the Cartel will assemble in London on June 19.

The subject of Continental competition was referred to at the annual meeting of the Birmingham Exchange on Thursday, March 13, by Mr. H. Bertram Hingley, the President. Reviewing trade conditions last year, he said that there was a distinct improvement on 1928, but a consideration of the figures of the world's consumption of iron and steel and Great Britain's share of the total output was not encouraging. The number of blast furnaces working in Great Britain in January, 1929, was 132, rising to 170 in August, but declining to 160 in December, and, while the total production was nearly 1,000,000 tons above that of 1928, it was 2,750,000 tons less than in 1913. In the steelworks a steady output had been maintained by all works in operation throughout the year, but the rate of expansion kept far behind the increase in the world's consumption of steel year by year, the increasing need for steel in all its varied forms being met by Germany, France and Belgium. In the ironworks engaged on the better qualities of iron and specialities, a much better production was obtained than for some years past.

A Welding Research Department and Training School.

The welding industry has to tackle exactly the same problems as the foundry trades. It has to ensure for itself a trained personnel and provide itself with fundamental knowledge of its machines and raw materials and a complete *raison d'être* for its failures.

Whilst classes have been established, they do not familiarise the operative with either potentialities of each particular type of machine or the execution of specialised jobs. The welding industry does not possess a national research association. A visit to the school and research department of the Quasi-Arc Company, Limited, 15, Grosvenor Gardens, London, S.W.1, fills one with admiration of the enterprise this firm has shown in doing their part to serve the industry for which they cater.

Fig. 1.—Welding School.

Fig. 2.—Chemical Laboratory.

The Welding School.

The welding school, a corner of which is shown in Fig. 1, has a dual purpose. Primarily, a firm considering the fabrication of an article by electric welding can send along their operators to be trained in the best methods available in the light of the firm's experience. The second endeavour is to permit unemployed welders to improve their knowledge pending re-engagement. Obviously, the school is used as a general demonstration plant, attached to the service department. Working in close conjunction with the district engineers and the designing department, new structures are suggested, approved and worked up into a finished article and finally tested out in the research department.

The Research Department.

This is divided into five sections—the chemical laboratory, mechanical testing, microscopical laboratory, electrical testing and the X-Ray department. For the conduct of these, a highly trained staff of engineers and metallurgists is maintained. Three of the departments are shown in Figs. 2 to 4.

The chemical laboratory is of the usual metallurgical type and is well equipped for rapidly determining the compositions of ferrous and non-ferrous metals and alloys, and their slags and fluxes. The mechanical testing laboratory is particularly interesting, as will be shown by a careful examination of Fig. 3. For tensile and compression there is centrally installed a Riehle machine. The machine in the left background is a modified type of Arnold alternating stress-testing machine. In this modified machine, butt-welded specimens are held by one end in a vertical position. To the top of the test-piece is communicated a horizontal movement, which stresses the sample beyond its elastic limit in the region of the weld, and the number of reversals before fracture is automatically registered. In the foreground a portion of an alternating torsional fatigue-testing machine is shown. In this, test-pieces of 20 in. by $2\frac{1}{2}$ in. by $\frac{3}{8}$ in. thick, which have been butt-welded centrally, are alternately twisted through either 10 or 15 deg. until fracture supervenes, the reversals being automatically registered. Corrosion tests are carried out on a bench shown at the right-hand side of the picture, and two machines have been devised which permit of immersion and removal from salt water or other solutions. Experience with these machines has shown that electric welds, when using suitable electrodes, do not corrode more rapidly than similar unwelded materials of construction. A Brinell hardness tester completes the equipment. The photomicrograph department contains a Leitz photomicrograph

(*Continued on page* 240.)

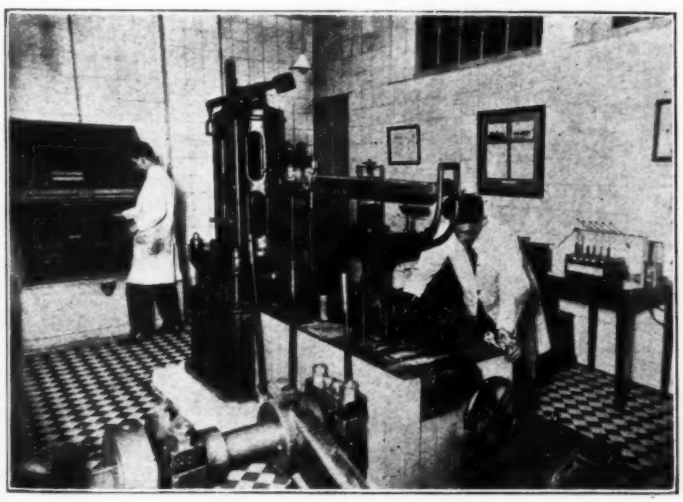


Fig. 3.—Mechanical Testing Laboratory.

Fig. 4.—Microscope Room.

Cast-Iron Castings of High-Silicon Content.*

In this classification are included cast irons containing from 5 to 18 per cent. Si. They possess remarkable properties of resistance to corrosion by hot or cold diluted sulphuric and nitric acids, as well as by cold diluted hydrochloric acid.

Up to 10 per cent. silicon content, these irons can be machined; above that, they can only be worked by grinding. At 5 per cent., the transverse strength even reaches about 19 tons per sq. in., but at 10 per cent. it falls to 9.5 tons per sq. in. with a deflection of 5 mm. The 18 per cent. silicon iron is very brittle and is devoid of all elasticity; on account of that, in its use, large variations of temperature must be avoided. It even happens, in the very high contents, that the metal is as hard as glass and is impossible to grind except with the greatest difficulty. In this case, the structure is shiny, whilst it should be dull in well fabricated metal;

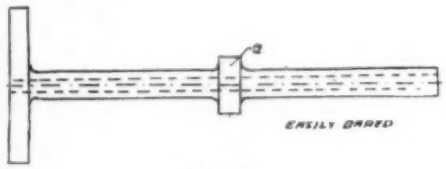


Fig. 1.

then also, it is extremely brittle and cracks on heating with great ease, very much greater than 18 per cent. iron with 1.8 to 2.0 per cent. shrinkage.

The higher the Si content is raised the lower is that of the C., as can be seen in the various analytical examples of Table I.

Table I.*

T.C.	Si.	Mn.	S.	P.
3.04	4.54	0.56	0.078	0.18
2.88	5.02	0.62	0.071	0.19
1.42	9.90	1.24	—	0.21
1.47	10.57	1.31	—	0.14
0.74	17.60	2.76	—	0.124
—	18.20	2.74	—	0.112

* The casting temperature of these irons is from 1,300 to 1,420 deg. C.

Concerning the composition of the charges, the author has thoroughly tried out the following mixtures, in which the steel scrap consists solely of rail ends and of springs.

I.—*For 5 Per Cent. Si Iron:*

(*a*) 20 lbs. of iron scrap containing 18 per cent Si; 80 lbs. of Duisburg pig.

(*b*) 25 lbs. of 10 per cent. ferro-silicon; 25 lbs.

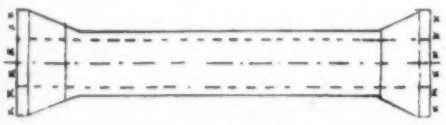


Fig. 2.

of iron scrap containing 10 per cent. Si; 50 lbs. of steel scrap.

(*c*) 50 lbs. of 10 per cent. ferro-silicon; 50 lbs. of steel scrap.

II.—*For 10 Per Cent. Si Iron:*

(*a*) 25 lbs. of 45 per cent. ferro-silicon; 25 lbs. of Duisburg pig; 50 lbs. of steel scrap.

III.—*For 15 to 18 Per Cent. Si Iron:*

(*a*) 63 lbs. of 45 per cent. ferro-silicon: 4½ lbs. of silico-spiegel; 82½ lbs. of steel scrap; 150 lbs. of scrap.

(*b*) 33 lbs. of 90 per cent. ferro-silicon; 6 lbs. of silico-spiegel; 111 lbs. of steel scrap; 150 lbs. of scrap.

(*c*) 27 lbs. of 90 per cent. ferro-silicon; 123 lbs. of steel scrap; 150 lbs. of scrap.

* Extracted from "Die Giessereipraxis."

The melting of silicon irons can be effected in the cupola up to 10 per cent., and even up to 18 per cent., but on condition of taking strict precautions the considerable separation of graphite tending to render the castings porous. During its passage in contact with the burning coke, the charge is enriched in carbon, but in the well this separates out and rises to the surface of the bath in the form of a graphitic scum; this scum continues to form up to pouring and sometimes continuing in the moulds;

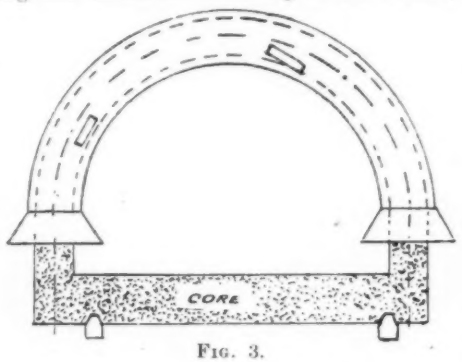


Fig. 3.

from this it is not rare to see the heads "rise," as sometimes happens in cast steel; in this case the casting is always porous and should be rejected.

That is why it is preferable, whenever possible, to melt the siliceous irons in the reverberatory furnace, the electric furnace, or the oil furnace. There are less wasters, and also the final composition of the metal is more definite. In every case the tendency to "rise" still persists, if the escape of the mould gases is not facilitated by every possible means.

Moulding should be carried out in a very permeable sand, when dealing with either green sand or dry moulds. Small castings only can be cast in green sand, and one must ensure that the sand is not too damp and that it is well

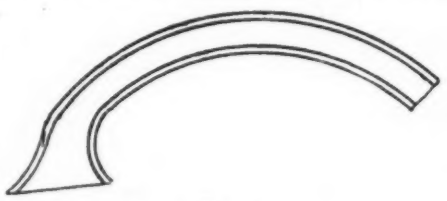


Fig. 4.

mixed, and one must vent the mould abundantly to prevent blown castings. All rather bulky castings should be poured in dry sand moulds. The moulds should be well smoothed and uniformly rammed; all roughness forming on the casting would interfere with the shrinkage, and so increase the danger of cracks. These moulds can only be entrusted to skilled and conscientious moulders.

The cores should also be made with great care in very permeable sand. The strength of the core-irons should be reduced to an absolute minimum, and as much coke as possible is placed in the large cores to facilitate their shrinkage. Oil-sand cores are very suitable, because after the cast they disintegrate and allow a free play for shrinkage. Oil sand can also be employed with profit for the moulds. They should be coated with a very refractory dressing of the highest quality.

The design of the castings to be moulded and the pattern-making should be very carefully studied. Sharp angles and sudden changes of section should be avoided and replaced by very generous fillets or by plane or conical connecting surfaces. Figs. 1 to 5 illustrate various examples.

In a casting such as the pipe shown in Fig. 1, with a circular boss "a" impeding shrinkage, this boss should be freed immediately after casting.

In pipes such as that shown in Fig. 2, where the flanges are connected to the body by parts in the shape of truncated cones, the terminal plane faces should be worked only by grinding. The sections are joined between them by collars in two pieces, being the flanges one against the other.

In the semi-circular pipe in Fig. 3 the core is solidly fixed in the span to avoid all lifting. A

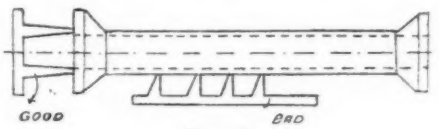


Fig. 5.

casting of this type should be top run by wedge-shaped runners, of which the positions are indicated in the figure. As soon as the metal is sufficiently set the core is withdrawn as swiftly as possible.

The pipe shown in Fig. 4 can only be cast successfully after several trials; at first, the very strong core-irons will not allow a sufficiently rapid withdrawal.

Fig. 5 shows the manner in which to place runners for long pipes. The runners placed at the end do not hinder shrinkage as do runners placed along the side. Short pipes, couplings, elbows, etc., are top run in order that the gates can be rapidly eased.

A Welding Research Department and Training School.

(*Continued from page* 239.)

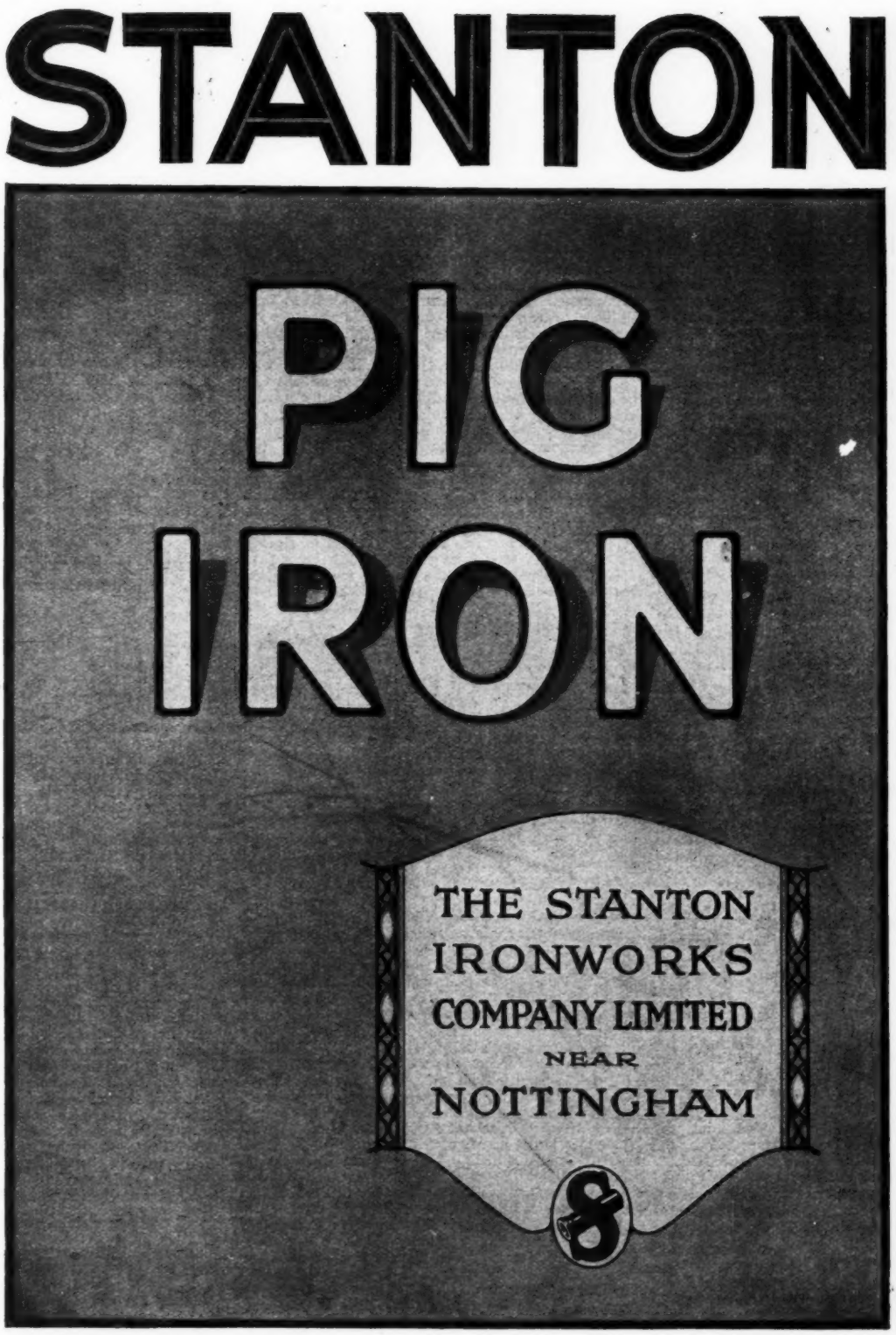
apparatus and various other types of microscopes, and, of course, adequate polishing and preparing machines.

There are two types of oscillographs by the Cambridge Scientific Instrument Company, Limited, in the electrical department, which, in addition, contains a very complete collection of electrical registering instruments. The oscillographs are capable of registering either on a photographic plate or a cinema film, the functioning of an arc. One is of the Duddell or electromagnetic type, and the other an Irwin or hot-wire type. The pictures derived show the deflections from the true sine curve in the case of A.C. current and enable the designer of electric machinery so to modify conditions that a steady arc is given, which *inter alia* prevents the occurrence of spluttering during operation.

The latest section to be created contains a Cox-Cavendish X-ray machine, giving up to 20 in. gap, which is used for obtaining radiographs of welds in plate up to 2 in. in thickness. The value of such a machine is obvious.

We congratulate the Quasi-Arc Company on the enterprise they show. It is a well-known fact that this company has done a large amount of pioneer work, and the well-equipped laboratories described have been built up for this purpose, together with the work of demonstration and instruction. The creation of these departments is especially commendable, as obviously the results obtained benefit the users of the electric welding process.

The British Non-Ferrous Metals Research Association of Birmingham has been elected a member of the American Foundrymen's Association.


STANTON
PIG
IRON
THE STANTON
IRONWORKS
COMPANY LIMITED
NEAR
NOTTINGHAM

Trade Talk.

The Whitford Steel Sheet & Galvanising Works, Briton Ferry, closed down on March 15. About 500 employees are affected.

According to a report from a Dutch source, the Krupp concern intends to put up large iron and steel works in the Dutch province of Limburg.

Messrs. Dorman, Long & Company, Limited, Middlesbrough, have booked an order for 5,000 tons of steel for a building construction scheme in Shanghai.

The Millom & Askam Hematite Iron Company, Limited, announce that iron-ore shipments at Almeria from their Alquife mines in February totalled 24,900 tons.

Messrs. Workman, Clark (1928), Limited, Belfast, have received an order from the General Steam Navigation Company, of London, for two cargo steamers of 1,100 tons deadweight each.

The Mersey Docks and Harbours Board has accepted a tender for electric cranes from Messrs. Babcock & Wilcox, Limited, and one for railway switches from Messrs. Hadfields, Limited.

Messrs. Fawcett, Preston & Company, Limited, machinery manufacturers and engineers, of Liverpool, have removed their London office from 70, Victoria Street to 21, Old Queen Street, Westminster, S.W.1.

The French Chemin de fer du Congo-Océan has placed an order with the Etablissements Corpet-Louvet for locomotives and tenders on the basis prices of 10,460 fcs per ton for locomotives and 5,900 fcs. per ton for tenders.

The South Durham Steel & Iron Company, Limited, West Hartlepool, have just completed the installation of plant for the generation of electricity, and will, therefore, cease to take their supply from the West Hartlepool Corporation's cables.

The Société des Hauts-Fourneaux de Saulnes have restarted their Hussigny works, which had been temporarily closed with the object of modernising the plant. The first blast furnace has been blown in, and a second is to be blown in shortly.

The Wolsingham steelworks of Messrs. John Rogerson & Company, Limited, which, it was recently announced, were soon to be closed down, are to have the pressing department kept running by the Sunderland Forge & Engineering Company, Limited.

A private company has been formed by Messrs. Ruston & Hornsby, Limited, Lincoln, under the title of Société Anonyme des Moteurs Ruston-Hornsby, 5, Avenue de la Republique, Paris, to develop their oil-engine business in France and the French Colonies.

The United Steel Works, A.G., intends to establish a new company, to be named the Ruhr-Stahl, A.G., which will comprise the Henrichs Steel & Iron Works, the Rhenish Westphalian Steel Works & Rolling Mills and the Witten Cast Steel Works, all of which the United Steel Works, A.G., has recently taken over.

A message from Cairo states that the Egyptian Ministry of Communications received thirteen tenders from Great Britain and the Continent for the construction of the new Kasr-El-Nil Bridge at Cairo. The lowest tender was received from Messrs. Dorman, Long & Company, Limited, with whom the order has been placed.

The "Carlton" patent flexible pipe joint was exhibited recently at the London office of the Sheepbridge Coal & Iron Company, Limited, 7, Victoria Street. The joint is of robust construction and the internal working parts are well enclosed. The flexibility permits of a radial movement of 4 ft. on a 3-in. pipe 18 ft. long.

Messrs. Swan, Hunter & Wigham Richardson, Limited, have launched on the Tyne H.M.S. "Scarborough," a sloop with main engines consisting of two sets of steam turbines, with single-reduction gearing. The engines and the two water-tube boilers are being built by Messrs. R. & W. Hawthorn, Leslie & Company, Limited.

The Driver Harris Company, of Harrison, New Jersey, U.S.A., have acquired the American rights of P.M.G. metal, which has been developed by the technical staff of the Barrow works of Vickers-Armstrongs, Limited. The properties of the material were first detailed on page 375 *et seq* of Volume XLI of The Foundry Trade Journal.

The directors of the Morgan Crucible Company, Limited, propose to alter the company's shares from £10 to £1 each. It is proposed to dissolve the present company and to vest its undertaking, assets and liabilities in a new company, under the same title, but with the capital reconstituted. The deferred ordinary share capital is to be increased from £431,600 to £2,158,000.

The International Manganese Corporation has been incorporated in the United States as a holding company to hold a percentage of the shares of a German corporation which is exploiting manganese concessions in South Anatolia, Turkey in Asia. It is estimated that there are at least 10,000,000 tons of manganese ore recoverable from mines situated about four miles from the sea coast. The ore is said to run about 45 per cent. manganese.

There was an outbreak of fire, on March 15, at the Dursley works of Messrs. R. A. Lister & Company, Limited. The firm have decided to transfer the construction work affected by the fire to the new machine shops which are now in course of erection. While the damage was very considerable, the only classes of goods seriously affected by the fire are auto-trucks, lighting plants and ploughs. The firm hopes to return to normal within a week or two.

Reference to the future policy of Messrs. William Beardmore & Company, Limited, were made by the chairman, Mr. H. A. Reincke, when presiding recently at a launch from the firm's Dalmuir shipyard. He said that those who recently shouldered the responsibility of shaping the company's destinies had approved of the board's programme for the modernisation of the Parkhead works. They were going to spend money on plant and machinery in an endeavour to improve the efficiency.

The executive committees of the engineering trade unions had a combined meeting in London on March 19, Mr. J. T. Brownlie presiding, and rejected the suggestion of a joint inquiry into working conditions and costs of manufacture in foreign countries. The employers suggested the inquiry in reply to the request of the unions for arbitration of the wage claim that was refused last November. The meeting decided to instruct a deputation of the unions to approach the Government to set up an inquiry on the lines of the present investigations into the cotton and steel industries.

The Electric Furnace Company, Limited, of 17, Victoria Street, London, S.W., have just received an order for an Ajax-Northrup high-frequency furnace of 25 cwts. capacity from a French steelworks, which had previously installed two smaller furnaces of the same type. This furnace will have an output of over 1 ton per hour. Since the first commercial-sized high-frequency furnace was installed in Sheffield, about 2½ years ago, the Electric Furnace Company, Limited, have installed or have under construction 27 Ajax-Northup furnaces, of a total capacity of 5,350 kilowatts, in addition to 78 laboratory-sized furnaces of the same type, which have also been supplied. The company has also recently received orders for a 3½-ton Héroult furnace for Spain, and for 64 tube heaters and 24 frame heaters for a French firm. Recent orders for Ajax-Wyatt furnaces include three furnaces of 24-cwt. capacity, which are larger than any other units that have yet been built, and a battery of six furnaces in another works, where a like number are already in operation.

Government contracts recently placed include the following:—Admiralty: Anchors, N. Hingley & Sons, Limited, Netherton; steel blooms, David Colville & Sons, Limited, Glasgow; William Beardmore & Company, Limited, Glasgow; English Steel Corporation, Limited, Sheffield. War Office: Iron piping, Stanton Ironworks Company, Limited, Nottingham; bullet-proof plates, Hadfields, Limited, Sheffield; steel billets, English Steel Corporation, Limited, Sheffield; steel sheets, Grovesend Steel & Tinplate Company, Limited, Swansea. Post Office: Steel masts, William Baird & Son, Limited, Glasgow. Crown Agents for the Colonies: Corrugated sheets, Wolverhampton Corrugated Iron Company, Limited, Ellesmere Port; cranes, Grafton & Company, Bedford; fishbolts, Nuts & Bolts (Darlaston), Limited; locomotive, Kerr, Stuart & Company, Stoke-on-Trent; locomotive spares, Sir W. G. Armstrong, Whitworth & Company, Limited, Newcastle-upon-Tyne; W. G. Bagnall, Limited, Stafford; Vulcan Foundry Company, Newton-le-Willows; steel, P. & W. Maclellan, Limited, Glasgow; steel poles, British Mannesmann Tube Company, Limited; steelwork, Sir Wm. Arrol & Company, Limited, Glasgow; Brandon Bridge Building Company, Limited, Motherwell; Dorman, Long & Company, Limited, Middlesbrough; F. Morton & Company, Limited, Liverpool.

Personal.

Mr. Charles Mitchell has been appointed managing director of Messrs. Dorman, Long & Company, Limited, and he will continue in charge of the bridge and constructional departments at 55, Broadway, London, S.W.1.

Mr. James Henderson, J.P., of the Frodingham Iron & Steel Company, Limited, has been appointed by the Board of Trade to be a member of the National Fuel and Power Committee in the vacancy created by the death of Mr. Maximilian Mannaberg.

An interesting ceremony took place at the works of the Suffolk Iron Foundry (1920), Limited, Stowmarket, on Monday, when a presentation was made to Mr. R. W. Lewin, sales manager, in view of his forthcoming marriage. Mr. L. J. Tibbenham, managing director, made the presentation.

Mr. Joseph Walker, who recently retired after having been in charge of the Chopwell coke ovens of the Consett Iron Company, Limited, for 31 years, was the recipient of presentations at a gathering recently. Mr. H. Hepburn, manager of Chopwell Colliery, made the presentations.

Wills.

Jenkins, A. T., chairman of Messrs. Robert Jenkins & Company, Limited, engineers, Rotherham £12,407

Strachan, George, a director of the Fairfield Shipbuilding & Engineering Company, Limited, Govan ... £83,090

Cradock, Lieut.-Col. Montagu, a director of the Metropolitan-Vickers Electrical Company, Limited, and the Westinghouse Brake & Saxby Signal Company, Limited £63,335

Senior, Albert, of Messrs. George Senior & Sons, Limited, Swedish iron and steel merchants, Sheffield, and a director of the Sheffield Forge & Rolling Mills Company, Limited £101,135

Obituary.

Sir Vincent Caillard, for 27 years a director of Messrs. Vickers, Limited, until his resignation in September, 1927, died in Paris last week, at the age of 73.

Sir James Readhead, Bt., chairman and managing director of Messrs. John Readhead & Sons, Limited, shipbuilders and engineers, South Shields, died last week, aged 77.

Mr. H. H. Doeg, whose death has occurred, was well known in Tyneside engineering circles. He was at one time commercial manager of Messrs. J. T. Eltringham & Company, shipbuilders and engineers, of South Shields and Willington Quay, and was afterwards associated with Messrs. G. T. Grey & Sons, engineers, South Shields, of which firm he became managing director, retiring four years ago.

Sir Robert Harvey, the eminent nitrate engineer and manufacturer, died at Falmouth on Friday, March 14, at the age of 82. Sir Robert Harvey was born at Truro, and was apprenticed to an engineer and ironfounder. He went to South America to set up copper-mining machinery at Tacopilla, in Bolivia, and on the completion of this task turned his activities to the nitrate fields. In 1875, on the expropriation of private speculation, he was appointed engineer-in-chief and inspector-general of the mining industries of the province of Tarapaca. He also completed extensive nitrate works at Buen Retiro, and the works of the Liverpool Nitrate Company at Iquique. He took a leading part in the development of South American industries, and was also largely interested in North's Navigation Collieries, South Wales.

New Companies.

Ardeer Foundry Company, Limited, Ardeer Foundry, Stevenston.—Capital £40,000. Directors: G. McGregor and W. L. McGregor.

Clayton & Shuttleworth, Limited, 3, St. Swithin's Square, Lincoln.—Capital £50,000 in £1 shares, to acquire the business carried on by Clayton & Shuttleworth, Limited, to adopt an agreement with Marshall, Sons & Company, Limited, and to carry on the business of agricultural and general engineers, etc. Directors: R. W. Matthews, C. H. Newsum, W. A. Colegate and Sir George D. C. Newton.

Telephones:
SHEFFIELD 22311 (3 lines)
LONDON 1483 Central
GLASGOW South 1580
WORKSOP 205
AMBERGATE 7
STOCKSBRIDGE 27
GALSTON 49

"SERVICE BCM/GX FIRST."

MANUFACTURERS & PRODUCERS OF REFRACTORY MATERIALS OF EVERY DESCRIPTION.
BRICKMAKERS · QUARRY AND MINEOWNERS CONTRACTORS & EXPORTERS.

GENERAL REFRACTORIES LIMITED

Incorporating
THE GENERAL REFRACTORIES CO., LTD. THE MIDLAND REFRACTORIES CO., LTD.
THOMAS BROOKE & SONS LTD. WORKSOP BRICK CO., LTD. GUISELEY SILICA CO. LTD.

Telegrams
"GENEFRAX"
Sheffield
London
Glasgow
Worksop
Monomarks
BCM/GX
BCM/ Magnesia
BCM/ Coroma
BCM/ Pyrolyte
BCM/ Insulite

KELHAM ISLAND MILLS SHEFFIELD • LONGROUNDS BRICKWORKS WORKSOP · Notts. • BULLBRIDGE BRICKWORKS AMBERGATE · Derbys • GAYTON ROAD MILLS KINGS LYNN • THE BATTS MILLS WOLSINGHAM · Dur. • BRACKENMOOR FIRECLAY WORKS · STOCKSBRIDGE • LOUDOUN MILLS GALSTON · Ayrshire
AND AT MANSFIELD, WARSOP, EBBERSTON, CORBRIDGE, BRAMCOTE, LUFFENHAM, TOW LAW, MONTGREENAN &c.&c.

LONDON OFFICE
20 Budge Row E.C.4. (M^r A.C. Turner)

Head Office:
Wicker Arches, SHEFFIELD

GLASGOW OFFICE
82 Dale St. C.5 (M^r A.W. Montgomery)

"EXTRA STRONG YORKSHIRE SAND"

is highly concentrated and will carry more floor or mixing sand than any other sand in the World.

Iron and Steel Markets.

Pig-Iron.

MIDDLESBROUGH.—An anticipated, but none the less welcome, development of the Cleveland price position has been disclosed by last week's decision of the Tees-side ironmasters that the hitherto firmly-fixed minimum quotations are immediately reduced by 5s. per ton all round. This announcement has for long been regarded as inevitable by consumers, who pointed to the fact that the furnaces must have benefited for some time past by the reduced cost of raw material and fuel, as evidenced by comparison with the figures quoted last October, showing that there has been a fall of 4s. in the price of blast-furnace coke and 3s. per ton in the value of foreign ore. Obviously, some adjustment of pig-iron quotations had become imperative, and, whilst declining industrial activity has tended to reduce the consumption of pig-iron, there is no doubt that the general conviction amongst consumers that the old level of prices could not much longer be maintained has kept them off the market and reduced business to very small proportions. Not only must this momentous decision have a beneficial effect upon home consumptive demand, but also as affecting the export trade on Tees-side by placing Cleveland foundry iron on a competitive level with Continental makers' quotations. On the whole, therefore, it may be said that the entire outlook for the Cleveland iron trade has been improved by the change of policy thus outlined. The revised quotations are:—No. 1 Cleveland foundry iron, 70s. per ton; No. 3 G.M.B., 67s. 6d.; No. 4 foundry iron, 66s. 6d.; No. 4 forge, 66s. per ton. This is the first change in Cleveland prices since June 11 of last year, and restores the quoted figures to within 6d. of the prices ruling between February and June of last year.

The market for East Coast continues in an unsettled condition, with prices distinctly inclined to lower levels and stocks steadily accumulating, whilst foreign competition is severely restricting the export trade. Thus it is not surprising to find sellers accepting 76s. per ton for mixed numbers and 76s. 6d. for No. 1 quality. These, moreover, are merely average prices, as values are a matter of individual bargaining. On the North-West Coast Bessemer mixed numbers are quoted at 79s. per ton at works.

LANCASHIRE.—Although so far unaffected by the recent reduction in Cleveland iron prices, consumers in this area are, not unnaturally, looking forward in anticipation of a similar movement on the part of the Midland producers, and meantime are refraining from purchasing beyond immediate requirements. Local markets, therefore, have been steady at the following quotations:—Derbyshire and Staffordshire qualities at 77s. per ton, including delivery to local consumers. There has been little movement either in Scottish iron at around 95s. per ton.

THE MIDLANDS.—Adhering firmly to a policy of holding off markets until some readjustment of prices is in sight, consumers of foundry pig in the Black Country area are only buying in moderate quantities pending a more active demand for castings, which, of late, has been rather on the slack side. Current quotations still rule as follow:—Northants No. 3, 75s.; North Staffordshire No. 3, 78s. 6d.; Derbyshire No. 3, 78s. 6d., and Scotch brands, 95s. to 97s., all per ton delivered local stations.

SCOTLAND.—No improvement can be reported in the markets for Scotch iron, quotations for which still remain at 78s. f.o.t. furnaces for No. 3 foundry. In view of the fall in Cleveland quotations buyers will be more pressing than before for a lower price. Producers still decline to reduce values, but it looks as if circumstances would be too strong for them, and that they will be forced to make some concession.

Finished Iron.

In the Black Country area, apart from the continued fairly consistent demand for Staffordshire marked bars, conditions are dull, and none of the iron makers is in a position to obtain business to keep the mills in regular operation. Marked bars are quoted at £12 10s. and crown bars at from £10 to £10 7s. 6d. The local ironworks are being poorly supported with business for nut and bolt iron, the price for which varies from £9 to £9 7s. 6d. Even at the low price quoted for Belgian iron there are no heavy tonnages being placed abroad, as the nut and bolt makers themselves are anything but busy.

Steel.

At Sheffield conditions in the steel market are unaltered, and business is somewhat erratic. Price-cutting is going on in Siemens acid-steel billets, and though the quotation is officially £9 10s. per ton, business is being done at as low as £8 15s. Even at this figure sales remain small. For basic billets the demand continues fairly good, despite the rivalry of imported billets. Wire rods are also subject to sharp competition from the Continent. Prices:—Siemens acid billets, £9 10s.; basic billets, soft, £6 10s.; medium hard, £7 2s. 6d.; medium, £8 2s. 6d.; hard, £9 2s. 6d. to £9 12s. 6d.; basic wire rods, soft, £8; medium hard, £9 15s. to £10; hard, £10 10s. to £11; acid, £12 5s. to £12 10s.; steel hoops, £9 10s. to £10. Rather more overseas business has been transacted in finished steel recently, and the inquiry from some of the overseas markets has a more genuine appearance than for some time past. In the tinplate market prices continue fairly steady, quotations ruling 18s. 3d. to 18s. 6d., coke quality, net cash, f.o.b. Welsh ports.

Scrap.

With few exceptions the markets for foundry scrap material continue quiet and inactive, with prices slightly irregular in some districts. On Tees-side merchants have shown a readiness to shade prices for suitable business, and as a result a few transactions have been put through at 61s. per ton for ordinary quality, whilst 64s. has been paid for good machinery quality in handy pieces. In the Midlands business passing in cast-iron scrap is only moderate in volume, with heavy machinery quality quoted 70s., ordinary 65s., and light 57s. 6d. to 59s., all per ton delivered. In Scotland quotations remain as follow:—First-class machinery, 67s. 6d. to 68s. 6d.; heavy ordinary, 64s. to 65s.; light qualities, 59s. to 60s., and cast-iron firebars, 57s. 6d., all per ton delivered f.o.t. consumers' works.

Metals.

Copper.—Recent movements in the markets for warrant copper have indicated some improvement in values, with, apparently, a continued upward tendency to higher levels. A further heavy increase has, however, been reported in American stocks of refined copper, amounting to about 30,000 tons, during the past month. This latest increase makes the total stocks available at refineries 233,000 short tons.

Closing quotations are:—

Cash.—Thursday, £68 5s. to £68 10s.; Friday, £69 12s. 6d. to £69 15s.; Monday, £70 5s. to £70 10s.; Tuesday, £70 7s. 6d. to £70 10s.; Wednesday, £70 17s. 6d. to £71.

Three Months.—Thursday, £67 2s. 6d. to £67 5s.; Friday, £67 17s. 6d. to £68; Monday, £68 5s. to £68 7s. 6d.; Tuesday, £67 17s. 6d. to £68; Wednesday, £68 7s. 6d. to £68 10s.

Tin.—After recording daily fluctuations disclosing some irregularity, the market for standard tin has developed a steadier tone, and the general feeling now is rather more optimistic. It is believed that the depression was largely due to forced liquidation, and it is hoped that, prices having reached bedrock, the position will become more satisfactory. The home statistical position, however, is not very good. There has been a considerable increase in the Liverpool stocks of late, and the total in London and Liverpool amounts to 15,376 tons.

Official closing prices:—

Cash.—Thursday, £164 2s. 6d. to £164 5s.; Friday, £164 15s. to £164 17s. 6d.; Monday, £169 10s. to £169 15s.; Tuesday, £170 to £170 5s.; Wednesday, £168 10s. to £169.

Three Months.—Thursday, £166 2s. 6d. to £166 15s.; Friday, £166 17s. 6d. to £167; Monday, £171 10s. to £171 15s.; Tuesday, £171 15s. to £172; Wednesday, £170 to £170 2s. 6d.

Spelter.—It is not surprising that Continental smelters are attempting to form a new combination to improve the state of the spelter market. The demand from consumers is poor, and there has been a heavy accumulation in the world's stocks.

Daily quotations are:—

Ordinary.—Thursday, £18 6s. 3d.; Friday, £18 12s. 6d.; Monday, £19 2s. 6d.; Tuesday, £18 10s.; Wednesday, £18 12s. 6d.

Lead.—The price of pig lead, as well as zinc, has dropped to the lowest level recorded since 1916. A certain amount of speculative buying resulted, and this was responsible for the subsequent recovery, and may not be regarded as a permanent improvement.

The week's prices have been:—

Soft Foreign (Prompt).—Thursday, £18 10s.; Friday, £18 12s. 6d.; Monday, £18 13s. 9d.; Tuesday, £18 10s.; Wednesday, £18 18s. 9d.

Third International Congress for Applied Mechanics.—This Congress will be held at Stockholm, August 24 to 29, 1930. The opening meeting will be held at the Royal Academy of Engineering Sciences, and regular sessions will be at the Royal Technical University. A complete programme will be announced later. Inquiries concerning the Congress should be sent to the secretary, Prof. W. Weibull, Kgl. Tekniska Högskolan, Stockholm, Sweden.

Stainless Iron.—A rust proof, stainless iron, known in Detroit as "Alleghany metal," has been produced in the Ford laboratories at Detroit, U.S.A., and is now being used for the bright-metal fittings of the Ford car. The process is at present a secret, but it is surmised that the new metal is very cheaply made from melted down scrap iron (probably treated with cadmium), is ductile, non-brittle, and lends itself readily to pressing. In colour it resembles, when buffed, highly-polished pewter.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 52 & 53. MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

ESTABLISHED 1863.

JAS. DURRANS & SONS, LTD.
PHŒNIX WORKS, PENISTONE, near SHEFFIELD.

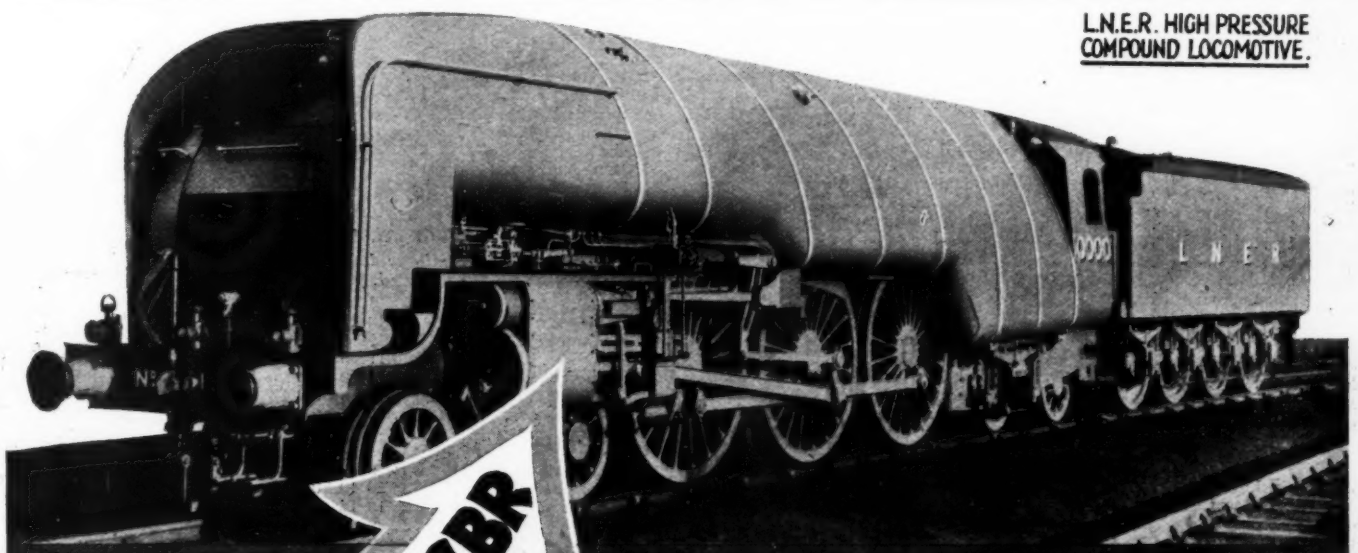
Telephone:
21 PENISTONE.
Telegrams:
"DURRANS, PENISTONE."

FOUNDRY EQUIPMENTS

LADLES,
FIRE BRICKS,
STONE FLUX,
CASTING CLEANERS,
PIPE NAILS,
SPRIGS,
WIRE BRUSHES,
BELLOWS,
CUPOLAS,
GANISTER,
LOAM AND SAND MILLS,
STUDS,
CHAPLETS,
BRUSHES,
CORE ROPES,
BUCKETS,
SPADES, Etc.

Write for Illustrated Catalogue on Blacking and Foundry Requisites.

L.N.E.R. HIGH PRESSURE COMPOUND LOCOMOTIVE.



WARNER CBR

WARNER CBR
CYLINDER PIG IRON.
SPECIFIED BY THE L.N.E.R. FOR THE CAST IRON LOW PRESSURE CYLINDERS OF THE ABOVE LOCOMOTIVE. THEIR COMPLETE CONFIDENCE IS THE RESULT OF LONG EXPERIENCE WITH WARNER CBR IN ALL THEIR LOCOMOTIVE CYLINDERS

WARNER & CO. LTD., CARGO FLEET MIDDLESBROUGH ON TEES
TELEPHONE — MIDDLESBROUGH 4265
TELEGRAMS — REFINERY, MIDDLESBROUGH

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	70	17	6
Three months	68	7	6
Electrolytic	83	5	0
Tough	75	5	0
Best selected	75	15	0
Sheets	110	0	0
India	90	0	0
Wire bars	84	5	0
Do. April	84	5	0
Do. May	84	5	0
Ingot bars	84	2	6
H.C. wire rods	86	2	6
Off. av. cash, February	71	10	3½
Do., 3 mths., February	68	18	6¾
Do., Sttlmnt., February	71	10	3
Do., Electro, February	83	17	6
Do., B.S., February	78	5	7½
Do., wire bars, February	84	5	0
Aver. spot price, copper, Feb.	71	10	3½
Solid drawn tubes			15d.
Brazed tubes			15d.
Wire			11¼d.

BRASS.

Solid drawn tubes	12¾d.
Brazed tubes	14¾d.
Rods, drawn	12¾d.
Rods, extd. or rlld.	7¼d.
Sheets to 10 w.g.	10¼d.
Wire	10¼d.
Rolled metal	10¼d.
Yellow metal rods	7¼d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8¼d.

TIN.

	£	s.	d.
Standard cash	168	10	0
Three months	170	0	0
English	169	5	0
Bars	173	0	0
Straits	172	5	0
Australian	172	5	0
Eastern	173	10	0
Banca	174	0	0
Off. av. cash, February	173	16	6
Do., 3 mths, February	176	14	9
Do., Sttlmt., February	173	15	7½
Aver. spot, February	173	16	6

SPELTER.

	£	s.	d.
Ordinary	18	12	6
Remelted	17	5	0
Hard	15	10	0
Electro 99.9	20	15	0
English	19	0	0
India	16	12	6
Zinc dust	26	0	0
Zinc ashes	5	0	0
Off. aver., February	19	9	10½
Aver., spot, February	19	4	2½

LEAD.

	£	s.	d.
Soft foreign ppt.	18	18	9
English	20	10	0
Off. average, February	21	2	10½
Average spot, February	21	3	9

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	28	0	0
Do. V.M. ex-whf.	26	5	0
Rods	30	0	0
Boiler plates	24	10	0
Battery plates	25	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	42	10	0
Chinese	29	10	0
Crude	20	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	22	17	6

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon—			
25%	7	17	6
45/50%	11	10	0
75%	19	0	0
Ferro-vanadium—			
35/50%	12/9 lb. Va.		
Ferro-molybdenum—			
70/75% c. free	4/2 lb. Mo.		
Ferro-titanium—			
23/25% carbonless	9d. lb.		
Ferro-phosphorus, 20/25%	£16	0	0
Ferro-tungsten—			
80/85%, c. fr.	3/- lb.		
Tungsten metal powder—			
98/99%	3/3 lb.		
Ferro-chrome—			
2/4% car.	£30	7	6
4/6% car.	£23	15	0
6/8% car.	£22	10	0
8/10% car.	£22	5	0
Ferro-chrome—			
Max. 2% car.	£33	12	6
Max. 1% car.	£38	5	0
Max. 0.70% car.	£40	2	6
70% carbonless	11d. lb.		
Nickel—99% cubes, or pellets	£175	0	0
Ferro-cobalt	9/6 lb.		
Aluminium 98/99%	£95	0	0
Metallic chromium—			
96/98%	2/7 lb.		
Ferro-manganese (net)—			
76/80% loose	£11	15	0
76/80% packed	£12	15	0
76/80%, export	£12	5	0
Metallic manganese—			
94/96%, carbonless	1/4 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	£0	2	2
Finished bars, 18% tungsten	£0	3	0

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{7}{16}$ in.	1/- lb.
Flats, ¼ in. × ¼ in. to under 1 in. × ¾ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	5	0	to	3	6	0
Bundled steel and shrngs.	3	0	0	to	3	3	6
Mixed iron and steel					3	0	0
Heavy cast iron					2	19	0
Good machinery for foundries	3	0	0	to	3	2	6
Cleveland—							
Heavy steel					3	1	0
Steel turnings					2	12	6
Cast-iron borings					2	8	0
Heavy forge					3	14	6
W.I. piling scrap					3	10	0
Cast-iron scrap	3	1	0	to	3	4	0
Midlands—							
Ord. cast-iron scrap					3	5	0
Heavy wrought					4	0	0
Steel turnings					2	0	0
Scotland—							
Heavy steel					3	5	0
Cast-iron borings					2	10	0
Wrought-iron piling					3	18	6
Heavy machinery					3	8	6

London—Merchants' buying prices delivered yard.

Copper (clean)	58	0	0
Brass	42	0	0
Lead (less usual draft)	16	10	0
Tea lead	12	10	0
Zinc	10	15	0
New aluminium cuttings	64	0	0
Braziery copper	54	0	0
Gunmetal	54	0	0
Hollow pewter	120	0	0
Shaped black pewter	87	0	0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	70/-
Foundry No. 3	67/6
Foundry No. 4	66/6
Forge No. 4	66/-
Hematite No. 1	76/6
Hematite M/Nos.	76/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	86/6
,, d/d Birm.	95/6
Midlands—	
Staffs. common*	—
,, No. 4 forge*	74/6
,, No. 3 fdry.*	78/6
Shrops. basic	—
,, Cold blast, ord.	—
,, ,, roll iron	—
Northants forge*	71/-
,, fdry. No. 3*	75/-
Derbyshire forge*	74/6
,, fdry. No. 3*	78/6
,, basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	80/6
,, No. 3	78/-
Hem. M/Nos.	81/-
Sheffield (d/d district)—	
Derby forge	69/6
,, fdry. No. 3	73/6
Lincs. forge.	71/6
,, fdry No. 3	75/6
E.C. hematite	89/-
W.C. hematite	91/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
,, fdry. No. 3	77/-
Northants foundry No. 3	—
Dalzell, No. 3 (special)	105/- to 107/6
Summerlee, No. 3	95/-
Glengarnock, No. 3	—
Gartsherrie, No. 3	95/-
Monkland, No. 3	95/-
Shotts, No. 3	95/-

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.		£	s.	d.
Iron—							
Bars (cr.) nom.					10	15	0
Nut and bolt iron	9	0	0	to	9	7	6
Hoops	10	15	0	to	11	5	0
Marked bars (Staffs) f.o.t.					12	10	0
Gas strip	10	15	0	to	11	5	0
Bolts and nuts, ¾ in. × 4 in.					15	5	0
Steel—							
Ship plates	8	15	0	to	8	17	6
Boiler plts.	9	17	6	to	10	10	0
Chequer plts.					10	12	6
Angles					8	7	6
Tees					9	7	6
Joists					8	10	0
Rounds and squares, 3 in. to 5½ in.					9	7	6
Rounds under 3 in. to ¾ in. (Untested)					8	2	6
					and upwards		
Flats—8 in. wide and over					8	12	6
,, under 8 in. and over 5 in.					8	17	6
Rails, heavy					8	10	0
Fishplates					12	0	0
Hoops (Staffs)	9	5	0	to	9	15	0
Black sheets, 24 g.					9	15	0
Galv.cor.shts., 24g.	11	17	6	to	12	5	0
Galv. fencing wire, 8g. plain					12	0	0
Billets, soft	6	2	6	to	6	12	6
Billets, hard	7	10	0	to	8	0	0
Sheet bars	5	15	0	to	6	5	0
Tin bars	5	15	0	to	6	5	0

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	1/3½
Sheet to 10 w.g.	1/4½
Wire	1/6
Rods	1/5
Tubes	1/9½
Castings	1/4

Delivery 3 cwt. free.
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
3/0 to 10 G.	1/7½ to 2/2½

with extras according to gauge.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2X foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	15.00
Basic	20.26
Bessemer	20.76
Malleable	20.76
Grey forge	19.76
Ferro-mang. 80% d/d	94.00
O.-h. rails, h'y, at mill	43.00
Bessemer billets	33.00
O.-h. billets	35.00
O.-h. sheet bars	33.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	2.12
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.85
Skelp, sheared steel	1.85
Steel hoops	2.20
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.30
Sheets, blue an'l'd, No. 13	2.25
Wire nails	2.25
Plain wire	2.40
Barbed wire, galv.	2.95
Tinplates, 100-lb. box	$5.25

COKE (at ovens).

Welsh foundry	27/6 to 30/-
,, furnace	17/6 to 22/-
Durham and Northumberland—	
,, foundry	15/6 to 16/6
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 box	18/3
,,	28×20 ,,	37/-
,,	20×10 ,,	26/6
,,	18½×14 ,,	19/3
C.W.	20×14 ,,	16/-
,,	28×20 ,,	34/3
,,	20×10 ,,	23/6
,,	18½×14 ,,	17/-
Terneplates	28×20	32/6 per box basis f.o.b.

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6	0	0	to	£7	10	0
Bars, hammered, basis	£17	10	0	to	£18	10	0
Bars and nail-rods, rolled, basis	£15	17	6	to	£16	15	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£32	0	0	to	£33	0	0
Faggot steel	£20	0	0	to	£24	0	0
Bars and rods dead soft, steel	£11	0	0	to	£14	0	0

All per English ton, f.o.b. Gothenburg.

TUBES AND FITTINGS.

Over ½ in. up to 6 in.

	Tubes.	*Fittings.*
Gas	65%	47½%
Water ..	61½%	42½%
Steam ..	57½%	37½%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
Mar. 20 ..	68	5	0	inc.	5/–
,, 21 ..	69	12	6	,,	27/6
,, 24 ..	70	5	0	,,	12/6
,, 25 ..	70	7	6	,,	2/6
,, 26 ..	70	17	6	,,	10/–

Electrolytic Copper.

		£	s.	d.		
Mar. 20 ..	83	5	0	No change	
,, 21 ..	83	5	0	,,	,,
,, 24 ..	83	5	0	,,	,,
,, 25 ..	83	5	0	,,	,,
,, 26 ..	83	5	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
Mar. 20 ..	164	2	6	inc.	52/6
,, 21 ..	164	15	0	,,	12/6
,, 24 ..	169	10	0	,,	95/–
,, 25 ..	170	0	0	,,	10/–
,, 26 ..	168	10	0	dec.	30/–

Tin (English ingots).

		£	s.	d.		
Mar. 20 ..	165	5	0	inc.	45/–
,, 21 ..	165	15	0	,,	10/–
,, 24 ..	170	10	0	,,	95/–
,, 25 ..	171	0	0	,,	10/–
,, 26 ..	169	5	0	dec.	35/–

Zinc Sheets (English).

		£	s.	d.		
Mar. 20 ..	28	0	0	No change	
,, 21 ..	28	0	0	,,	,,
,, 24 ..	28	0	0	,,	,,
,, 25 ..	28	0	0	,,	,,
,, 26 ..	28	0	0	,,	,,

Spelter (ordinary).

		£	s.	d.		
Mar. 20 ..	18	6	3	inc.	1/3
,, 21 ..	18	12	6	,,	6/3
,, 24 ..	19	2	6	,,	10/–
,, 25 ..	18	10	0	dec.	12/6
,, 26 ..	18	12	6	inc.	2/6

Lead (English).

		£	s.	d.		
Mar. 20 ..	20	0	0	No change	
,, 21 ..	20	0	0	,,	,,
,, 24 ..	20	0	0	,,	,,
,, 25 ..	20	10	0	inc.	10/–
,, 26 ..	20	10	0	No change	

AVERAGE MONTHLY PRICES OF IRON HOOPS.

Year.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1896	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 2 6	6 5 0	6 10 0	6 3 0
1897	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 8
1898	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 10 0	6 15 0	7 0 0	6 11 6	
1899	7 0 0	7 0 0	7 0 0	7 0 0	7 12 6	10 12 6	8 12 6	8 12 6	8 12 6	9 2 6	9 7 6	9 17 6	8 2 9
1900	9 17 6	10 7 6	10 7 6	10 7 0	10 12 6	7 12 6	10 12 6	10 12 6	10 12 6	9 17 6	9 2 6	9 2 6	10 3 8
1901	9 2 6	8 2 6	8 2 6	7 12 6	7 12 6	7 12 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 11 2
1902	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1903	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 0
1904	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6	7 2 6
1905	6 17 6	7 0 0	7 0 0	7 0 6	7 0 0	7 0 0	7 2 6	7 2 6	7 2 6	7 2 6	7 0 0	7 7 6	7 2 0½
1906	7 10 0	7 17 6	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 7 6	7 15 1½
1907	8 7 6	8 7 6	8 7 6	8 7 0	8 7 6	8 7 6	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 0 0	8 7 1
1908	8 0 0	7 10 0	7 10 0	7 10 6	7 10 0	7 10 0	7 10 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 6 8
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0
1910	7 1 10½	7 0 3	7 7 6	7 7 0	7 7 6	7 7 6	7 7 6	7 7 6	7 7 6	7 6 3	7 5 0	7 5 0	7 6 5
1911	7 5 0	7 5 0	7 5 0	7 5 6	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 8 9	7 10 0	7 10 0	7 6 2½
1912	7 12 6	7 12 6	7 12 6	7 15 0	7 15 0	8 2 6	8 2 6	8 2 6	8 12 6	8 12 6	8 12 6	8 15 0	8 2 3½
1913	8 17 6	8 17 6	8 17 6	8 17 0	8 17 6	8 17 6	8 17 6	8 7 6	8 7 6	8 7 6	8 7 6	7 17 6	8 12 6
1914	7 17 6	7 17 6	7 17 6	7 13 9	7 12 6	7 12 6	7 12 6	9 2 6	9 2 6	9 2 6	9 2 6	9 2 6	8 6 4½
1915	9 3 6	9 18 1	10 7 6	10 16 6	10 17 6	13 2 6	13 2 6	13 2 6	13 7 6	14 2 6	15 2 6	15 18 6	12 10 1
1916	17 2 6	17 2 6	17 2 6	17 6 3	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 7 6	17 6 1
1917	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1918	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6	17 2 6
1919	17 2 6	17 2 6	17 2 6	17 2 6	24 6 3	24 6 3	24 6 3	25 2 6	26 7 6	26 7 6	26 7 6	26 17 4	22 14 9
1920	28 0 0	28 12 6	33 15 0	35 5 0	35 15 10	38 17 6	38 17 6	38 17 6	38 17 6	38 17 6	36 17 6	35 14 9	
1921	29 1 3	23 5 0	21 12 6	20 0 0	20 0 0	20 0 0	17 5 0	15 0 0	14 4 0	13 15 0	13 10 0	12 18 0	17 5 10
1922	16 5 0	15 13 9	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 4 6½
1923	14 0 0	15 0 0	15 0 0	15 0 0	15 6 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 16 0	14 15 0	14 18 3½
1924	14 15 0	14 15 0	14 15 0	14 15 0	14 15 0	14 13 9	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 12 4½
1925	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1926	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	12 10 0	12 10 0	14 3 4
1928	12 10 0	12 7 6	12 0 0	11 13 6	11 15 0	11 12 6	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 14 10½
1929	11 10 0	11 10 0	11 10 0	11 10 0	11 9 0	11 5 0	11 5 0	11 5 0	11 5 0	11 2 0	11 0 0	11 0 0	11 5 11
1930	11 0 0	11 0 0	—	—	—	—	—	—	—	—	—	—	—

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

18, BENNETTS HILL, BIRMINGHAM.

PIG IRON

REGISTERED TRADE MARK

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

19, ST. VINCENT PLACE, GLASGOW.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-.

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Foreman desires position; experienced all branches Engineering, Motor and Jobbing work; thorough knowledge of cupola, mix grey iron, semi-steel, and non-ferrous metals by analysis; can estimate and fix piecework prices.—Box 468, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

BRASS FOUNDRY FOREMAN requires situation. Good practical moulder; age 40.—Box 480, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

A FIRST-CLASS MAN is wanted by large aluminium foundry (Birmingham) as Assistant Foundry Manager. This is an important post and demands proved administrative ability and up-to-date experience in modern methods of production.—Box 484, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN (Iron) required. Must be used to the production of parts required in the motor trade.—Write, giving full particulars, Box 482, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PARTNERSHIP.

INVESTMENT.—Advertiser wishes to invest in Iron Foundry or small Engineering Works with Foundry in Midlands or South. Can bring business and wants part-time employment.—Write, Box 476, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of SHOPPING,

Compact and Convenient.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1930 edition now ready. Order your copy now. Price 42s., bound in cloth.—INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

SAND MIXERS. — New and Secondhand Ask us to quote.—W. BREALEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

FOUNDRY LADLES.

One 5-ton Geared Ladle, £22 10s
One 6-ton Geared Ladle, £25.

CRANE.

One 3-ton "MORRIS" Hand-operated Overhead Travelling Crane for 41 ft. 6 in. span, £50.

For further particulars, etc., write, Box 478, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY—*Continued.*

AIR Compressor, Ingersoll Rand, 9 x 8, ERI, with Receiver and Motor, 28-h.p., 440 v., 50 cycles, A.C. Almost new.—WATSON, Gow & COMPANY, Falkirk.

ONE "Thwaites" Rapid Cupola, as new, size 4, capacity 3 to 4 tons per hour, casing 3 ft. 6 in. dia., overall height 24 ft. 8in., drop bottom with receiver at side. Price, with one set of bricks (new), £85.—MOBBS & COMPANY, LIMITED (In Voluntary Liquidation), Lion Foundry, Northampton.

CRANE LADLES!

10-ton McNeil Ladle, as new, £50.
8-ton Evans Ladle, as new, £45.
6-ton Evans Ladle, good, £32.
4-ton Evans Ladle, good, £24.
2-ton Evans Ladle, good, £18.
All above worm- and bevel-geared.
Any Ladle sent on approval.
50 smaller Ladles and Shanks in stock.

A. HAMMOND, 14, Australia Road, Slough.

THOS. W. WARD, LTD.,

22-in. x 105-in. LANDIS Plain Grinder.
8-in. x 32-in. UNGER Universal Grinder.
BRYANT No. 6 Chucking Grinder, chuck range 12 in.
NEW "BLANCHARD" Type Vertical Surface Grinder, with 19½ in. dia. chuck.
VERTICAL COCHRAN BOILER, 11 ft. 9 in. x 5 ft. 3 in., working steam pressure 100 lbs. per sq. in.
FOUNDRY LADLES, various types and sizes.
20,000 ft. 1-in. New Black Steel Screwed and Socketed Piping in lengths of 18 ft. and upwards. Tested to 210 lbs. hydraulic pressure.
1921-make 6-wheel 13-in. LOCOMOTIVES (Manning Wardle); copper firebox; brass tubes; 160 lbs. w.p.
HORIZONTAL DOUBLE-GEARED STEAM WINCHES, 4½ in. x 6 in. stroke to 10 in. x 15 in. stroke, suitable for hauling.

(ASK FOR "ALBION" MACHINERY CATALOGUE.)

ALBION WORKS, SHFFFIELD.

WORM-GEARED CRANE LADLES:—
48 in. by 44 in. by 50 in. deep.
44 in. by 38 in. by 44 in. deep.
36 in. by 34 in. by 34 in. deep.
Fitted with phosphor-bronze gears.
Several Hand Ladles, 4 to 15 cwt.

HARRY, Wellfield, Llanelly.

PATENTS AND TRADE MARKS.

PROTECT YOUR IDEAS.—Free, Advice and Handbook on patenting inventions and registering trade marks by Registered Agent with 43 years' experience.—KING'S PATENT AGENCY, LIMITED, 146A, Queen Victoria Street, E.C.4.

MISCELLANEOUS.

NON-FERROUS CASTINGS. — Inquiries solicited from the Trade. Prompt attention; first-class products; reasonable prices.—PRECISION CASTINGS, LIMITED, Lincoln Street, Wolverhampton.

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

"PURIC" CUPOLA FLUX in Block Form cleanses and desulphurises all cupola mixtures. No increase in cost of mixtures, but actual saving obtained, owing to the production of better metal and owing to less wear on the furnace linings.

Over 600 foundries have testified to the advantage of using "Puric." Send for trial cwt.—Write, BEECROFT & PARTNERS, LIMITED, The Foundry Chemists, Retort Works, Mappin Street, Sheffield.

Foundry Consultants and Advisors. Analyses and Testing carried out at low rates at The Laboratories, St. Peter's Close, Sheffield.

MISCELLANEOUS—*Continued.*

RAIN Water and Soil Connections. Large quantities. Good condition.—WATSON, Gow & COMPANY, Falkirk.

STRAW Ropes and Wood-Wool Ropes for cores and packing purposes. Lowest prices. Best quality. Reliable service. For further information see our half-page advertisement, this Journal, adv. page 18, of March 20.—WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

GANISTER, best quality for cupolas, also for Steel Works.—ASTBURY SILICA COMPANY, "The Brooms," Park Lane, Congleton.

LINSEED OIL.—30 barrels of Raw Linseed Oil, suitable for foundry use, available for immediate disposal at the price of 10 per cent. below current market values.—Write, Box 474, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FLUORSPAR. — The Ideal Flux for all Foundry and Furnace work; supplied in crude lump, washed gravel or finely ground. Samples and prices from

A. BECK,
MINEOWNER, MATLOCK.

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed. There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future. Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received. Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,

SCHOOL FOR THE BLIND
(FOUNDED 1838)
SWISS COTTAGE, LONDON, N.W. 3

Phone: 287 SLOUGH

MOULDING MACHINES

Two Britannia head ram machines	£24 each
Two No. 1 Britannia jar ram machines	£38 each
One 48" × 24" Darling & Sellars turnover	£28 (new)
One 24" × 20" Jackman hand turnover	£18

SAND PLANT

One "Jackman" ball-bearing sandmixer	£16
Two "Macdonald" electric gyratory sifters	£11 each
Two "Macdonald" pneumatic sifters	£11 each
Two 6 feet overdriven sandmills	£40 each

LARGEST STOCK OF FOUNDRY PLANT IN ENGLAND. PLEASE SEND FOR LISTS.

BUY FROM ME AND SAVE MONEY

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH